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AUTOMOTIVE INDUSTRIES

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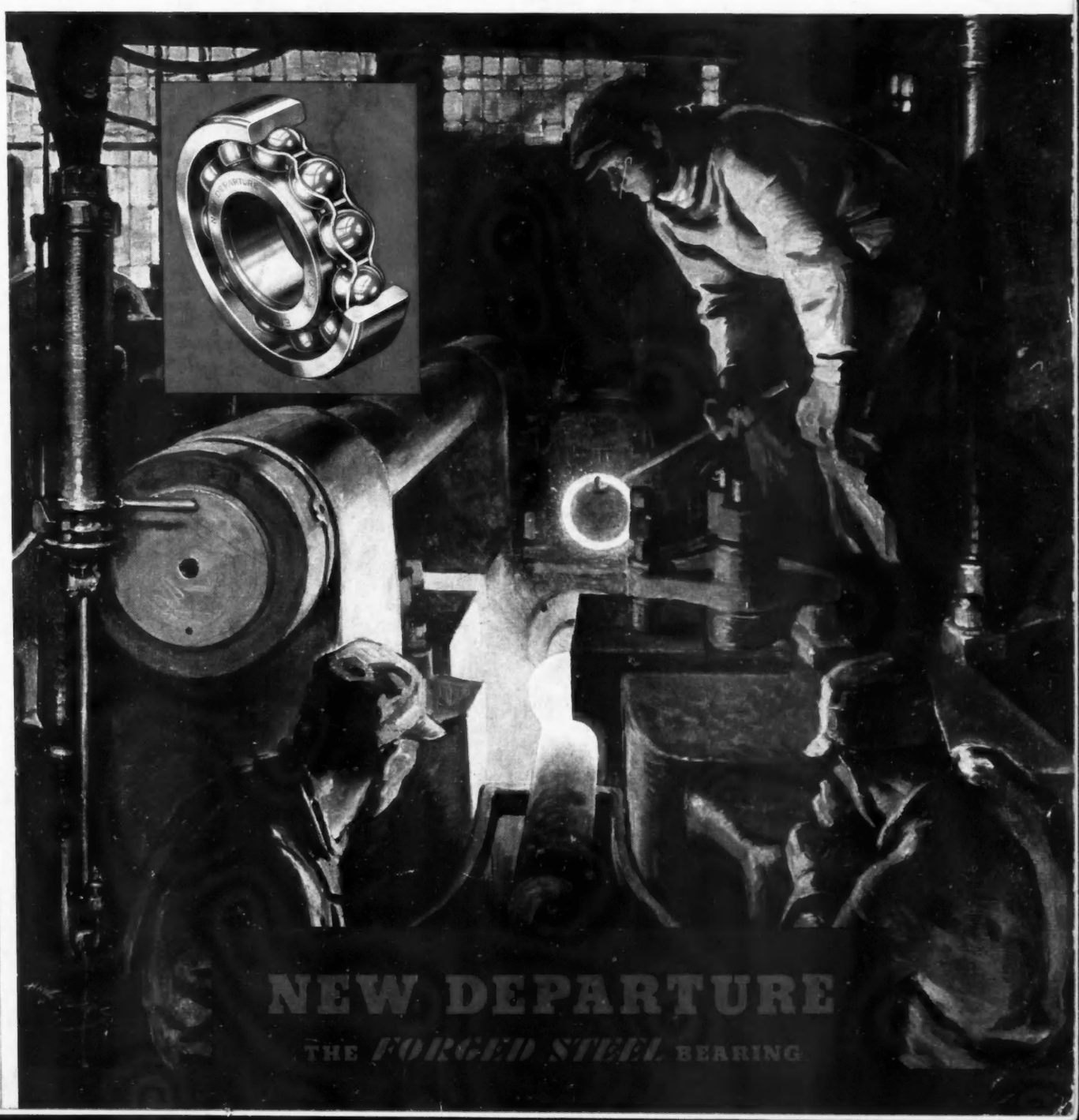

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STANDARD OIL COMPANY (INDIANA)

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 82 Number 3

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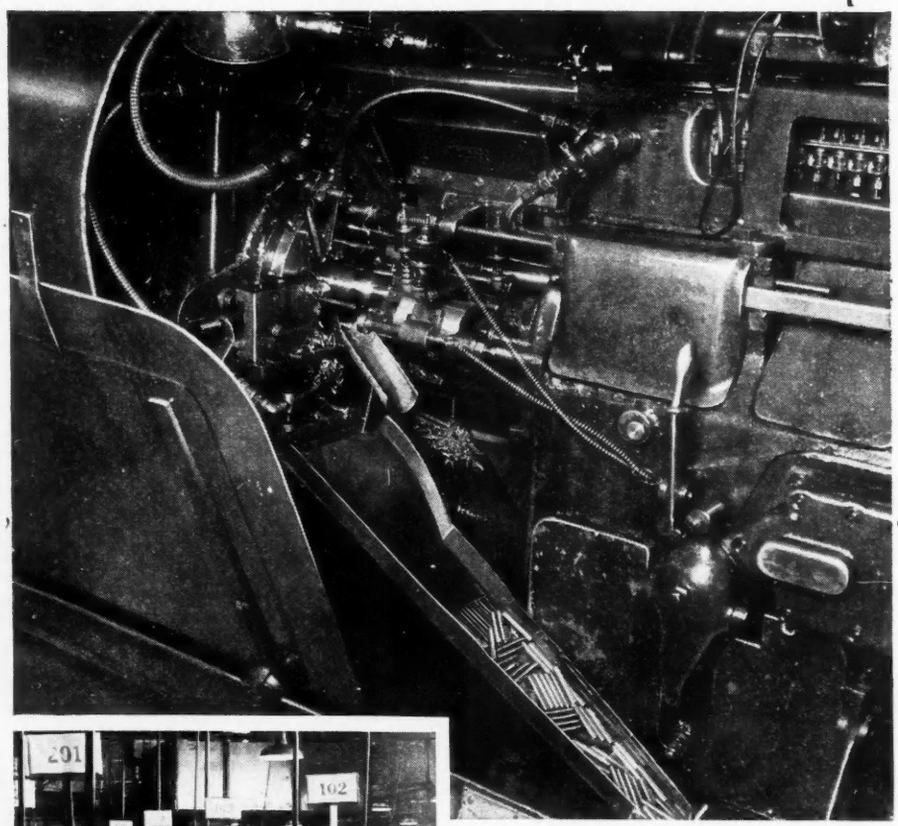
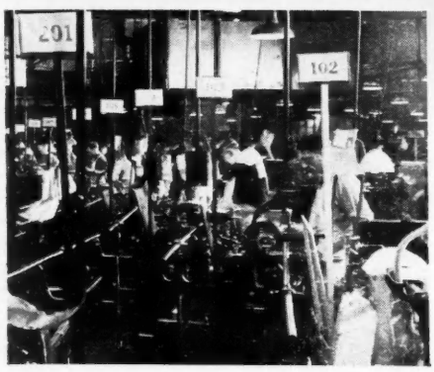
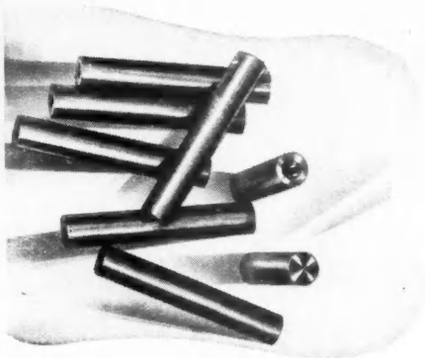
MAGNET CORES drilled, tapped, cut off



600
pieces
an hour



CLOSE-UP of Acme-Gridley Automatic Screw Machine in well-known plant* where Texaco Sultex Cutting and Soluble Oils have replaced all other brands.
**Name on request.*



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MACHINE—Acme-Gridley Automatic.

SURFACE SPEED—180 feet per minute.

PRODUCTION—600 pieces an hour.

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You, too, can improve results by using Texaco Sultex Cutting and Soluble Oils. Our engineers are at your service; phone the nearest of 2279 warehouses, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

TEXACO SULTEX
CUTTING AND SOLUBLE OILS

IN THIS ISSUE . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.
Volume 82 Feb. 1, 1940 Number 3

NO RECORD survives of the exact date when printing from movable type made its first appearance. Certainly it was some time around the middle of the fifteenth century and certainly it was the one invention which of all others made possible the broad diffusion of knowledge. Like all great inventions it was not without its attendant evils. As printing became widespread, types were made smaller and it was necessary to invent spectacles to compensate for both facts. Printing spread the knowledge of both good and evil . . . mechanized, it made possible the postage stamp and printed money. In short, before the radio, it was the basis for social action on a large scale.

By internation consent, the year 1940 has been chosen as the one in which to celebrate the five-hundredth anniversary of the Invention. As a product of the printer's craft, AUTOMOTIVE INDUSTRIES pauses with thousands of publications, publishers; with millions of printers all over the world to salute the memory of the inventor —probably Johann Gutenberg—who made possible the begining of the printed word.

In nearly every country of the world, the year 1940 will see special celebrations of many kinds, arranged in honor of Gutenberg and the invention of printing. In the five hundred years of its flourishing, the invention has changed but little in its essentials. A great deal of printing is still done from single types which are used over and over again and distributed into receptacles between each job. Such types are set by hand, and occasionally, impressions from them are made by hand too.

As nearly as the scholars can tell, Gutenberg's invention combined the casting of single types, with the use of a vertical screw or lever press, and the provision of a viscous ink which would adhere to the metal surface of the type. Possibly he figured out the classic composition of type-metal alloy, which has remained about the same for 500 years without essential improvement.

It may be argued that these things are far removed from the normal concerns of automotive engineers. But one may recall also that at least one engineer attained equal distinction in the field of automotive engineering and printing.

Alphonse Legros, sometime president of the Institution of Automobile Engineers (England), became interested in the mechanics of printing relatively late in his career, but found time to visualize and produce a fat book on "Typographical Printing Surfaces" which became a classic in the field.

The conjunctive smell of paper and printer's ink has an effect on certain individuals which is more powerful than marijuana in its workings. All of us here are of the company which has sniffed and found it good.

When one German printer meets another in any part of the world he says: "Gott gruss die Kunst"—God preserve the Art. We echo that now.

ENGINEERING

SAE Annual Meeting Draws Thousand Members — **Page 91**

Many the speakers and many the papers that contribute much to the growing data on things automotive. In this issue practically every contribution has been briefed. A reading will augment your notes if you attended and if not will prove a pretty good substitute.

PRODUCTION

Producing 1,750,000 Speedometers a Year — **94**

Sounds something akin to the Amos and Andy radio skits, but that is just what is being done year after year at the Stewart-Warner plant in addition to horde of other automotive production turned out in very sizable lots. How such large production is handled and what the peculiarities of such a setup are is the story that Joseph Geschelin rounds out this month in his usual telling style.

MARINE ENGINES

The Motor Boat Show — **104**

Too often one gets into a rut of thinking that all things automotive are automobiles. On the other hand there has been some very effective engineering on marine engines that the automobile engineer can well sit up and take note of. The Motor Boat Show at New York brings the whole subject to a head. A lot of new things in power plants presented themselves this year. In this article they are both shown and described.

Business in Brief 93

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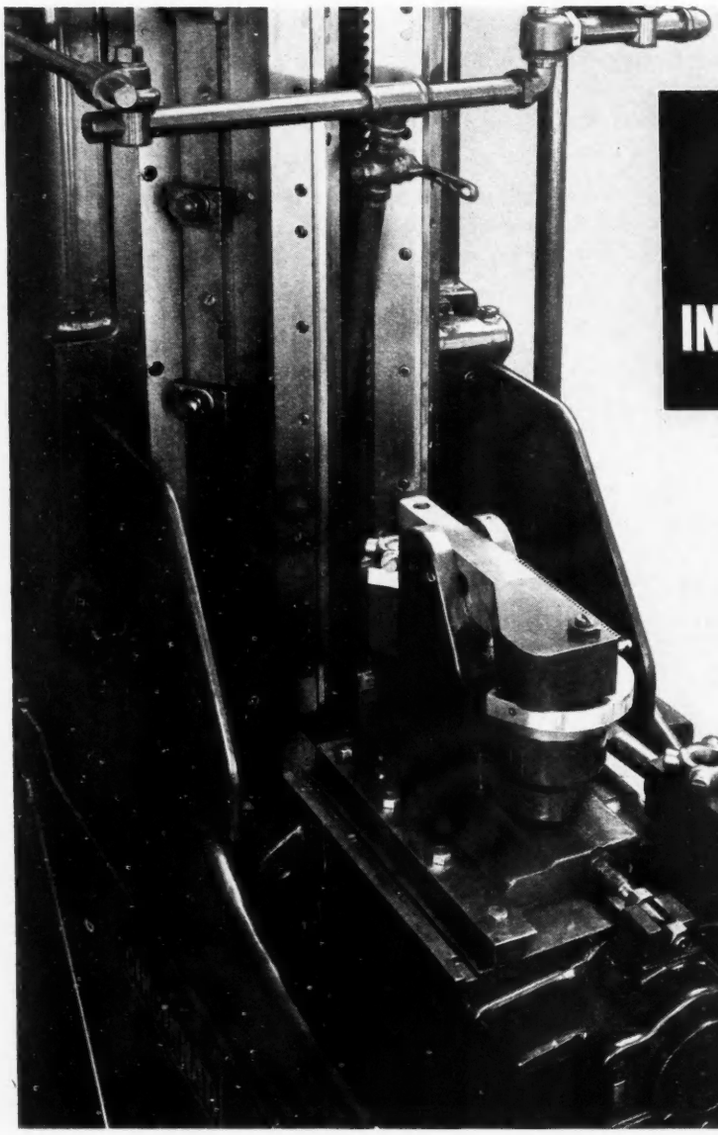
Production Lines 118 **News of the Industry 121**

Since 1913 all issues of AUTOMOTIVE INDUSTRIES have been indexed in the *Industrial Arts Index*, which can be consulted in any public library.



BROACHING THE ENDS — FOUR OF THEM — IN ONE STROKE OF THE RAM

CINCINNATI

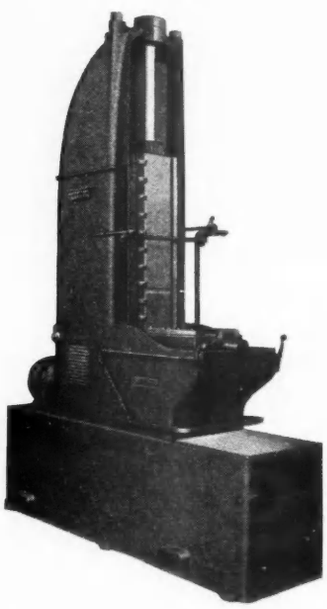
A SYMBOL OF A DEFINITE STANDARD OF WORTH

Broaching four ends of universal yokes in one stroke may sound like a fairy tale, but it *can* be done successfully. Here's the way the CINCINNATI Sales Engineering Department solved the problem for an automotive manufacturer.

First of all, a CINCINNATI No. 5-54 Single Ram Vertical Hydro-Broach does the job. At the top of the stroke, the table advances the work under the cluster of four broaching cutters and automatically clamps it. In one downward stroke, the four ends of the part are finished to size, removing about 3/16" stock from each end. At the completion of the cutting stroke, the table retracts and unclamps the work, and the ram returns to the top of the stroke.

With this setup, production averages 204 parts an hour with very little effort expended by the operator.

Perhaps many parts in your own shop could be produced more economically on CINCINNATI Broaching Machines. Our engineers will be glad to give you cost reducing recommendations.



● CINCINNATI Single Ram Vertical Hydro-Broaching Machine, Catalog M-834.

THE CINCINNATI MILLING MACHINE CO.
Cincinnati, Ohio, U. S. A.

AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

Vol. 82, No. 3
February 1, 1940

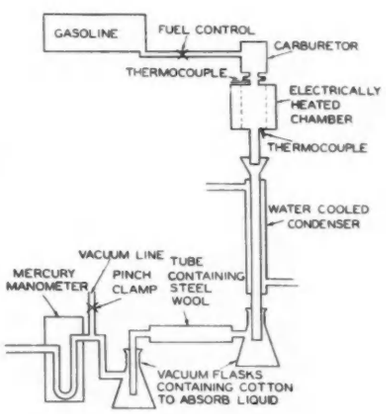
SAE Annual Meeting Draws Thousand Members

FIVE days—21 sessions—50 papers. That's the statistical summary of the annual meeting of the Society of Automotive Engineers, held in Detroit from Jan. 15 to 19. The opening session on Engine Deposits vs. Fuel Additives found J. A. Moller of the Pure Oil Co. on the rostrum and close to a thousand engineers in seats in the Crystal Room of the Book-Cadillac. The high opening attendance was maintained throughout most of the technical sessions and at the Detroit-Section-sponsored banquet at which William L. Batt, president of SKF Industries, Inc., laid the groundwork for a new understanding between management, labor and government.

ABSTRACTS by P. M. HELDT

Fuel Additives and Engine Deposits

THE EFFECT of some fuel additives on engine deposits has been studied by the research department of the Pure Oil Company and the methods and results were discussed in a paper by Joseph A. Moller and Harry L. Moir of that company. Deposits in the intake manifold and on the cylinder crown were considered. The term "additive," of course, is a very general one, but it appeared that the additives investigated are those having lubricating properties and which are depended upon to improve the lubrication of the top end of the cylinders.



Apparatus for quantitative solvent test on gum solvents in the atomized state.

The effects of additives on manifold deposits were studied by means of the apparatus shown in the sketch. After leaving the carburetor the mixture passes over and around a plate upon which a predetermined amount of gum has been evenly deposited. A known amount of fuel (with or without the additive) is passed through at a definite rate, and the plate is weighted before and after the run. Runs are made successively with the plain fuel, the fuel with additive, and the plain fuel.

In determining deposits on the piston crown, use was made of removable crowns screwed into the piston skirts. Amounts of deposits were determined by weighing the piston crown before and after a run. Photographs were taken of the combustion-chamber surfaces of the cylinder head.

In the course of the investigation it was observed that deposits are always in wave-like formations, one type appearing to travel inwardly and converging, another traveling outwardly and diverging. An explanation of this phenomenon was attempted in the paper.

Aluminum Fuel Tanks for Aircraft

ALUMINUM fuel tanks are widely used on aircraft, according to E. H. Dix, Jr., and R. B. Mears of the Aluminum Research Laboratories, Aluminum Company of America. The principal advantages of aluminum for this purpose are its light weight and its relative freedom from corrosion. Dry gasoline does not corrode aluminum, but badly contaminated water which sometimes collects at the bottom of the tank may corrode it. Three different types of material are used for the tanks, viz., non-heat-treatable alloys, heat-treatable alloys, and Alclad sheet.

To prevent corrosion, the tanks should be so designed as to permit free drainage of water to the sump. Metals in the fuel system should be selected with a view to preventing electrolytic action. The fuel should be so handled that it will not pick up water, iron rust or other corrosion products of heavy metals before it is introduced into the tank. Protective coatings may be applied to the inner walls of the tank. By one process, known as the Alrok, a porous surface

is formed by treating the metal with a suitable liquid, which then has an inhibitive chemical such as potassium dichromate applied to it. Alternatively, the surface may be Alumilited (anodized) and then impregnated with potassium dichromate. Protective coatings of a paint which is not dissolved by the fuel to any extent are also used. Paints with a phenolic-resin vehicle and a zinc-chromate pigment meet this requirement, and both the Alrok and the Alumilite treatments form an excellent base for such a coating.

Other precautions against corrosion consist in the use of corrosion inhibitors either in the form of capsules put into the tanks or as additions to the fuels. Periodic cleaning of the tank interiors, or flushing them with inhibited solutions, may also prove beneficial.

Rudder Control of Four-Engined Planes

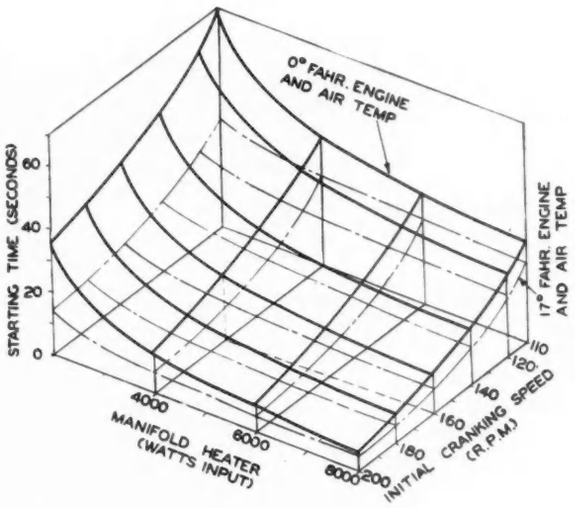
WITH multi-engined planes it sometimes happens that one engine stalls during the take-off, and the control of the plane with the rudder then presents a difficult problem. Methods of solving this problem were discussed in a paper by Clarence L. Johnson, chief research engineer of Lockheed Aircraft Corporation. To avoid such trouble, the author said, the aircraft should be able under reasonable field conditions and with full load, to clear a 50-ft. obstacle 3000 ft. from the start of the take-off run (with zero wind) regardless of which engine fails on a four-engined plane. This condition should be met with engine failure at any point beyond 1500 ft. from the start of the take-off run. Up to this point the plane could be stopped on the ground in any normal field. The pilot should not be expected to juggle throttles, trimming controls, landing gears, flaps and air speeds during the critical 10 seconds after take-off.

Cold Starting of Diesel Engines

THE starting of high-speed Diesel engines in cold weather is quite a problem, according to L. E. Lighton and H. O. Riggs of the Electric Storage Battery Co., who presented a paper on Observation on the Cranking of Diesel Egines. In testing various commercial engines with respect to their starting characteristics, these authors found that it is necessary to crank them at about one-tenth their rated operating speed in order to ensure satisfactory firing. The minimum cranking speed is dependent on the compression ratio, the pistons, the method of fuel injection, and the method of applying heat for low-temperature starting. In cold weather it is necessary to build up the cranking speed to the normal idling speed of the engine before releasing the starting motor. Intermittent firings are depended upon for this build-up in speed, for to obtain a cranking speed equal to the normal idling speed by means of starter power alone would require a battery of prohibitive size.

To facilitate starting in cold weather, heat may be supplied to the air charge either by a glow plug in a precombustion chamber or by an electric heater in the inlet manifold. Continuous cranking, of course, heats up the cylinder, but cranking for a long period exhausts the battery and is therefore undesirable. The starting time can be reduced by either in-

(*Turn to page* 106)



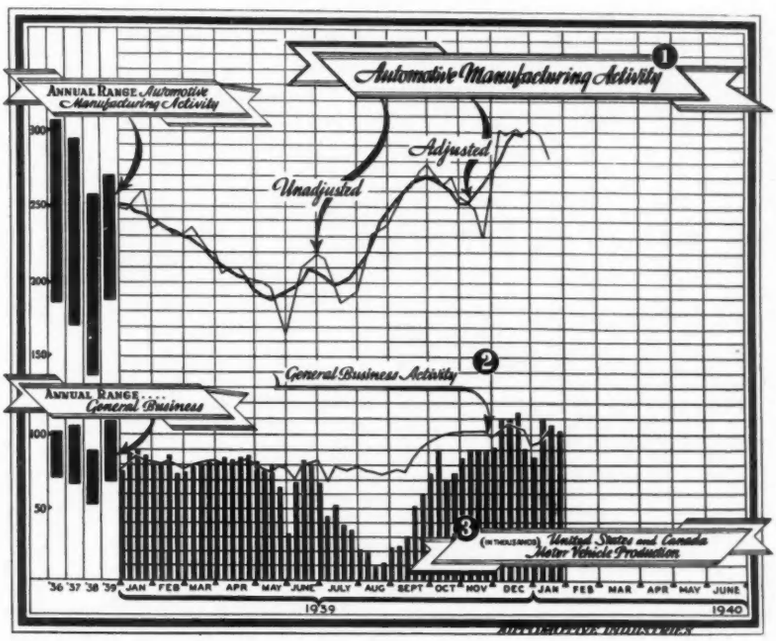
Effect of cranking speed and rate of heat supply to manifold on starting time (for a 500 cu. in. engine)

The Brass-Hat Rack

"I see the old man is mad at the parts manufacturers again!"

BUSINESS IN BRIEF

Our own view of automotive production and sales; authoritative interpretation of general conditions


Automotive Manufacturing Activity
1
Annual Range Automotive Manufacturing Activity
Adjusted
Unadjusted
General Business Activity
2
Annual Range General Business
3
(In thousands) United States and Canada Motor Vehicle Production
'36 '37 '38 '39 JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1939
1940

Weekly indexes of automotive general business charted

Output Geared to Sales for '40

PRODUCTION of cars and trucks tapered off slightly during the latter half of January, although preliminary estimates[3] showed that weekly output continued to run above the 100,000 unit mark, an unusually high rate which indicated that the January total undoubtedly would set a new high record for the month. Highest previous January was in 1929 when 422,538 cars and trucks came off the lines.

It is estimated that manufacturers turned out approximately 102,000 cars and trucks during the week ending Jan. 27, and the week ending Feb. 3—of which three working days should be credited to January—was expected to be slightly lower or approximately 100,000 cars and trucks. These estimates, added to those for previous weeks in the month, would place total January output at approximately 460,000 cars and trucks.

February schedules were dependent on final sales reports covering the second and third 10-day periods of January, but both daily and weekly rates were expected to be somewhat lower because of the seasonal tapering off in sales that appeared to be living up to normal expectations. Some producers previously on weekly schedules of five days went to four days during the latter part of January and were expecting to remain so to keep field stocks in balance until the anticipated spring pickup begins to make itself felt. Others had trimmed daily schedules slightly, or expected to do so beginning with February.

General Motors divisions continued to be the heaviest producers during January, although there was a slight tapering off in output during the latter half of the month in most divisions. Ford divisions and Chrysler divisions which followed General Motors in that order, maintained even rates throughout the month, although it was expected that February would see some tapering off by these producers also. Independent producers also had slightly lower schedules during the latter part of January and were expecting to gear output closely to sales during the balance of the winter production season pending the spring sales spurt.

The industry's estimated 40 per cent gain in production during 1939 over 1938 was verified by retail sales figures covering cars and trucks in the United States released on Jan. 25 by the Automobile Manufacturers Association. Total retail deliveries of passenger cars and trucks in the United States during 1939 were 3,244,537 units, according to the A.M.A., a gain of 38.4 per cent over 1938. Passenger car sales, totaling 2,723,946, showed a 39.2 per cent gain over 1938 and commercial vehicles totaling 520,591 were 34.4 per cent higher.

AUTOMOTIVE MANUFACTURING ACTIVITY as reflected by the unadjusted index charted herewith regained its peak of 302 during the week ended Jan. 6, fell to 298 the following week and then dropped 15 points to 283 in the week ended Jan. 20. The lagging adjusted index climbed to 294 in the week ended Dec. 16, reached higher to 300 during the week ended Dec. 23, and dropped a point to rest at 299 for the week ended Dec. 30.

[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp., New York. 1926 = 100; [3] Estimated by J. A. Laansma, Detroit News Editor, AUTOMOTIVE INDUSTRIES.

Looking down one of the mechanized speedometer assembly lines

Producing 1,750,000

By JOSEPH GESCHELIN

STEWART-WARNER CORP.—a name synonymous with speedometers since the inception of the automotive industry—traces its beginnings to some 27 years ago when it was chartered as the Stewart-Warner Speedometer Corp. Since 1905 the company has produced an average of 1,750,000 speedometers a year.

Around the turn of the century, John K. Stewart, founder of the business, was engaged in the manufacture of power-driven sheep shears in which power was transmitted through a flexible shaft revolving in a flexible tube. Subsequently the same form of drive was adapted to a speedometer, transmitting power from a wheel on early motor cars. Although this form of drive has been improved in many respects, the principle adapted from sheep shears remains the standard type of drive on the motor cars of today.

This is the Forty-fifth in the series of monthly production features

The name Stewart-Warner was adopted when John K. Stewart's company, Stewart and Clarke, merged with the Warner Instrument Company, more than a quarter of a century ago. Today, Stewart-Warner is known as one of the most prominent producers of speedometers and automotive instruments, supplying

Manufacturing eighteen basic types of automotive equipment in large quantities at Stewart-Warner has developed techniques epitomized in

Speedometers a Year

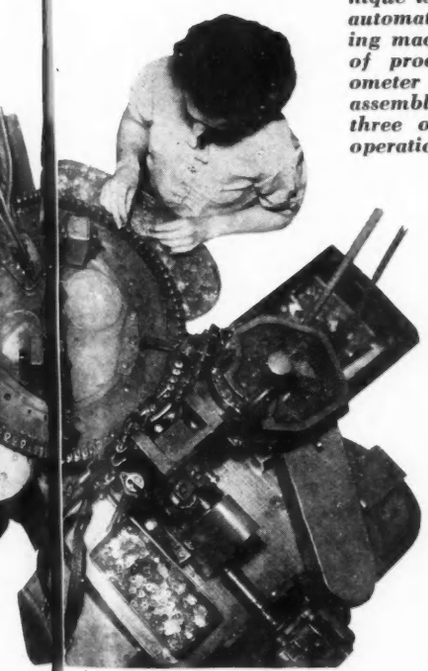
some eighteen basic types of equipment for the automotive industry. One of its latest products is the South Wind car heater, operating on the unique principle of burning fuel drawn from the carburetor, supplying full heat flow within 90 sec.

Still more recent are such important accessories as the electric speedometer for bus operation. and the electric windshield wiper which has been adopted as standard equipment by one of the fine car makers.

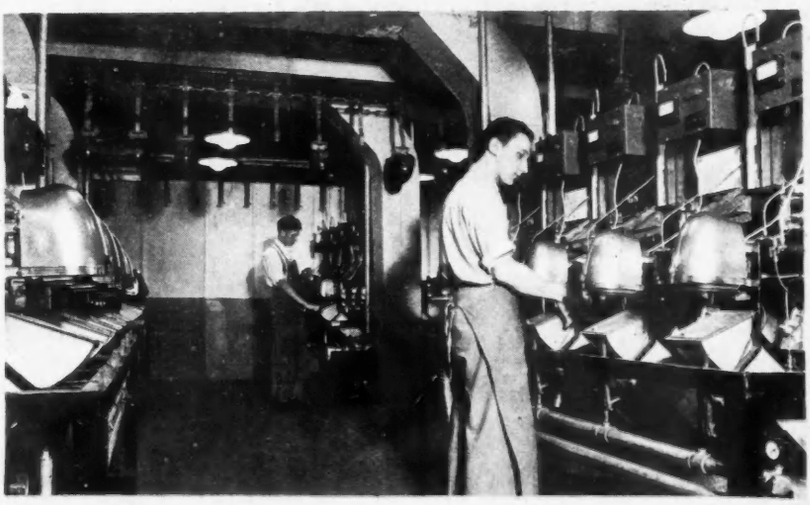
Alemite lubrication was introduced to the automotive industry in 1917 and is widely used in all manner of transportation equipment and machinery. This business was acquired by Stewart-Warner in 1924.

Manufacturing operations are conducted in seven wholly-owned plants, comprising over 50 acres of floor space. For the automotive units, the main plant contains 985,957 sq. ft. of floor space; the die casting plant, 337,500 sq. ft.; Bassick plant, 337,500 sq. ft. (not wholly automotive); Canadian plant, 32,572 sq. ft.

The Stewart Die Casting division, also located in



Product of motion-study technique is this interesting semi-automatic assembly and welding machine which is capable of producing 20,000 speedometer bracket and pinion assemblies in a day. It takes three operators to keep the operation moving at top speed



Every South Wind heater that comes off the assembly line is subjected to a test schedule simulating actual operating conditions

PRODUCTION

Stewart-Warner Corporation and Subsidiaries

STEWART-WARNER CORPORATION

Main Plant, Chicago, Ill.
Household Appliance Division, Indianapolis, Ind.
Stewart-Die Casting Division, Chicago, Ill.

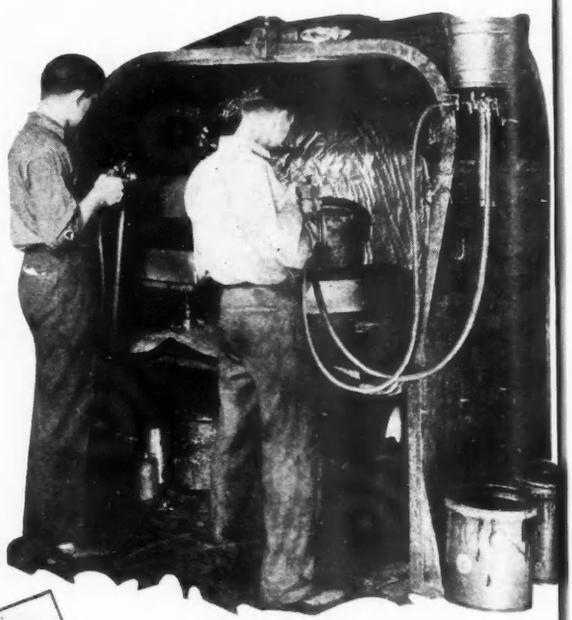
SUBSIDIARIES

The Bassick Company, Bridgeport, Conn.
Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ont., Canada
Alemite Corporation, New York, N. Y.
The Alemite Company of Northern California, San Francisco, Cal.
Stewart-Warner Distributors Company, Chicago, Ill.
Stewart-Warner Distributing Company, Birmingham, Ala.
The 37 West 65th Street Corporation, New York, N. Y.

Chicago, is one of the oldest die-casters in the industry. Supplying a group of some 235 different customers, this plant produces an amazing variety of die castings, principally of high purity zinc alloy, some of aluminum alloy. It is of interest to note that in common with other die-casters, this unit designs and builds its own die casting machines. Recently they installed a battery of fifty of the latest type hydraulic machines representing an investment of $300,000.

As a producer of fine instruments for all manner of uses, and of equipment which in general relies upon small, accurate sub-assemblies, Stewart-Warner has based its entire manufacturing philosophy on the concept of "Quality First." This slogan, implying a high degree of quality control at every step, is so prominently displayed in every department of the plant that even the casual visitor is impressed with this emphasis upon quality. Closer inspection will reveal that quality control is exercised in every manufacturing operation, in the set-up of sub-assemblies, in the final calibration of assembled instruments.

In addition, there is a master inspection department whose function it is to check every production part in process against the working drawings, using



Some 40,000 parts of various kinds are sprayed daily in the enamelling department with the aid of DeVilbiss equipment shown here

One of the large die casting machines found in the die-casting division

One of the assembly lines in the auto radio department, featuring assembly of radio automatic tuning unit

parts drawn by sampling from production departments.

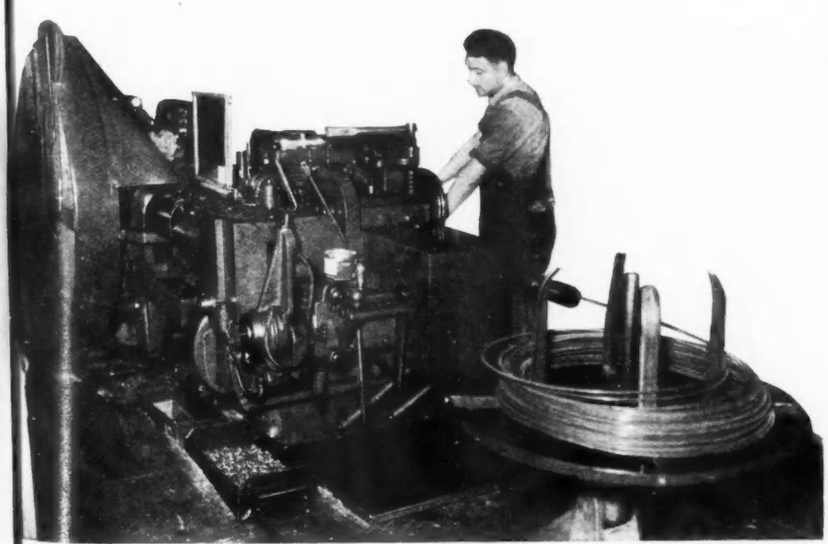
On the surface there is nothing particularly spectacular about the manufacture of small parts such as are found in this operation. Yet because of the tremendous quantities required for certain parts—large figures even in mass production—the production man will find many examples of impressively unique techniques and processes. In fact in several instances the methods employed differ quite radically from what might be termed common practice.

Outstanding example of what we have in mind is the tiny but mighty important self-tapping Alemite fitting. Yearly production runs between 150 million and 175 million fittings, was up to 168 million in 1937. One of the fittings, commonly used, is produced at the rate of 46 millions per year.

Another example is that of the odometer wheel or dial. Some idea of the production problem may be gaged from the fact that each speedometer has ten or more of these dials, and with a yearly speedometer output of 1,750,000 this places odometer dial production at considerably over 17,500,000 pieces. Ignoring the many conventional ways in which this part could be produced, this organization has developed a method of forming it by coining from a small pellet of aluminum. Interesting feature of the production set-up is in the variations of numeral marking since the speedometers are intended for use the world over. Examination of the stock of stencils reveals special identification for Persia, for Turkey, for China, for Japan. And, of course, special calibration of the speedometer itself, to take into account the different measures of distance in vogue in foreign climes.

Generally speaking, the production facilities found in the Chicago main plant are of conventional character except for the use of many items of special machinery, unique assembly lines for each of the instruments and accessories, and specialized inspection and calibration devices. We have appended a condensed list of the principal production departments to picture more clearly the nature of the operation as well as to indicate the manner in which the fabrication of various units has been sub-divided.

Here will be found one of the largest automatic screw machine departments in the industry, comprising some 385 machines, including Brown & Sharpe, Davenport, New Britain Gridley, National Acme Gridley, valued at $1,000,000. This is supplemented with a hand screw machine department containing some 161 machines, valued at $300,000. Many parts are produced in the punch



Alemite fitting bodies are formed from alloy steel stock on this No. 2 Manville cold heading machine

press department which boasts a battery of some 325 units. Some of the smaller, high speed presses fitted with automatic progressive dies turn out as many as 10,000 pieces per hour.

There is a comprehensive plating department capable of handling all of the manifold requirements of the product. Facilities for electroplating include—chromium, cadmium, nickel, bright nickel, copper zinc, and tin. The chromium plating equipment includes a new acquisition, featuring a modern unit with an automatic plating conveyor.

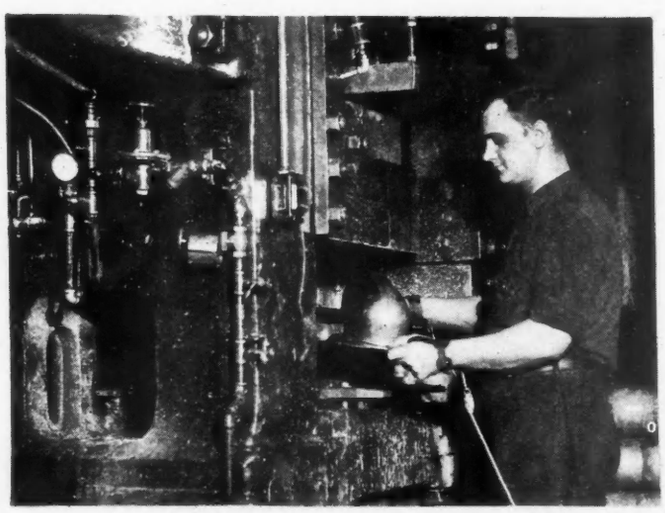
The production departments are served by excellent facilities which mark a self-contained manufacturing organization—tool rooms for producing the various standard and special cutting and forming tools, a die department which produces the press shop tooling, a special division for making gages and inspection equipment, and a maintenance department.

With this brief background study, let us examine the methods employed in the fabrication of some parts typical of this operation. Consider, first, the Alemite fitting which is made by the millions yearly. An entire fitting as we see it in finished form is born of a bit of alloy steel wire, fed automatically from coils into a special automatic heading machine which upsets the wire into the desired forms. Next the thread is rolled, the fitting drilled, and the headed fittings assembled with the tip. Fittings are hardened in cyanide furnaces, under controlled conditions, quenched in water. Finally, they are given a corrosion-resisting treatment of cadmium-plate in barrel-plating equipment, using some 60,000 lb. of cadmium anode material annually.

One of the most interesting features of the process is the automatic assembly of the ball-and-spring check valve, prepared on a large battery of special full automatic assembly machines. Each machine consists, essentially, of a revolving turn-table with a multiplicity of stations to accommodate the fittings, loaded by the operator. To each turn-table is attached a clever spring-winding machine which makes the tiny springs automatically from spring wire fed into it from coils. At the opposite end of the turn-table the fittings are ejected automatically into a hopper.

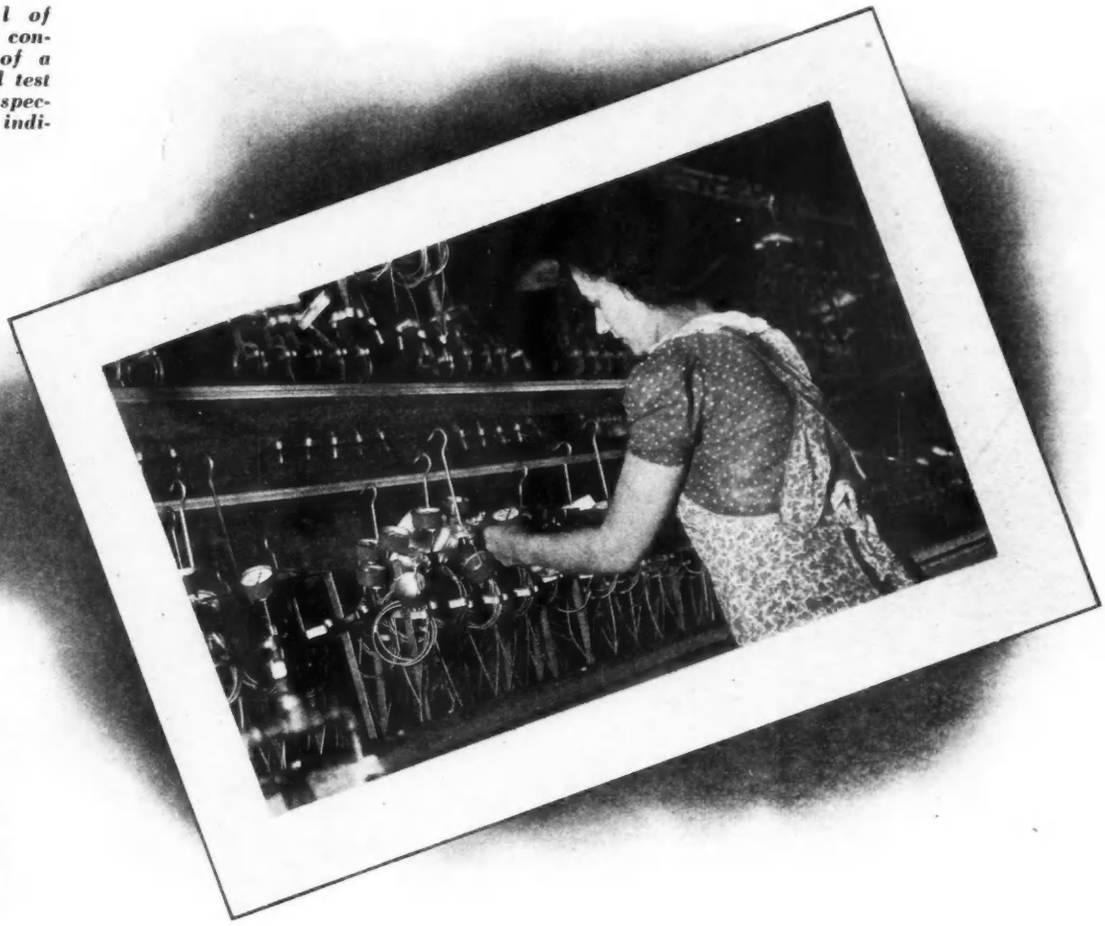
Another of the outstanding processes is that of producing the odometer dial. Here again is a technique made possible by the demand for millions of similar parts. The piece is made from small aluminum slugs in a series of simple press punch operations. The first step is the coining of the dial in one operation from the slug. Then the blank is pierced, rough-

(Above) 50 KVA Roth welding machine produces the heater case and flare assembly, comprising three separate parts which require 16 spot welds to complete the unit



(Right) The heater housing is formed in this 250-ton, Model 58½ Toledo press with air cushion

(Right) Typical of painstaking quality control is this view of a section of the final test and adjustment inspection line for heat indicators



(Below) One of the light machine lines, this one set up for reaming the speedometer adapter joint case. A 2-spindle Avey drill press is shown in the foreground

swaged, finish-swaged, countersunk on both sides, and acid dipped to remove burrs. Next the background is sprayed on. This is done on a small merry-go-round table conveyor fitted with vertical spindles on which the dials are stacked, sprayed with an automatic nozzle. Following this, the dials are transferred to special automatic printing machines for embossing the numerals. Final step is the spraying of clear, air-drying lacquer on another of the automatic spraying machines.

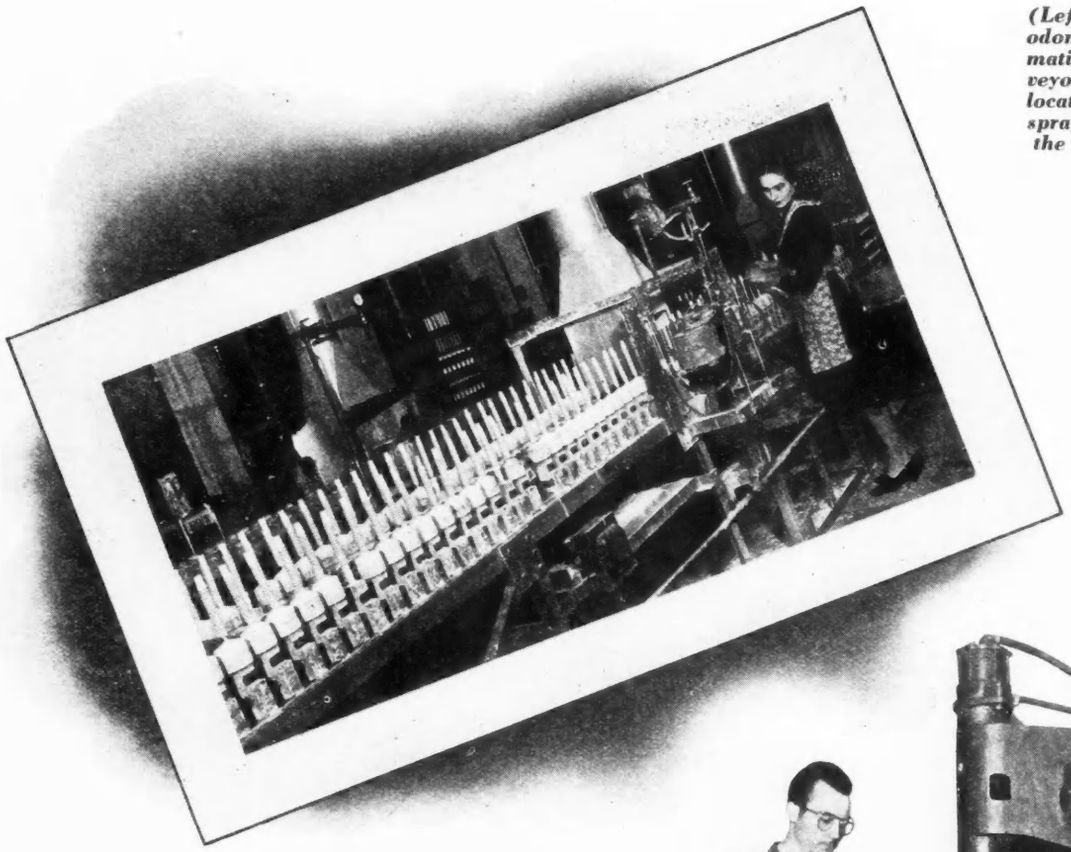
As an example of light machining we may consider the speedometer frame. This is an aluminum alloy die casting, trimmed and burred before machining. In a series of successive drill press and automatic machine operations, the frame is reamed, hollow-milled, tapped, and spot-faced. The magnet shaft hole, which is the focal element of the part, is broached, and then the entire part is burred, washed to remove chips and oil, and inspected ready for the assembly line.

The speedometer assembly division, by far the largest single department in the plant, boasts four double final assembly lines for handling the variety of instruments intended for its many customers. In addi-

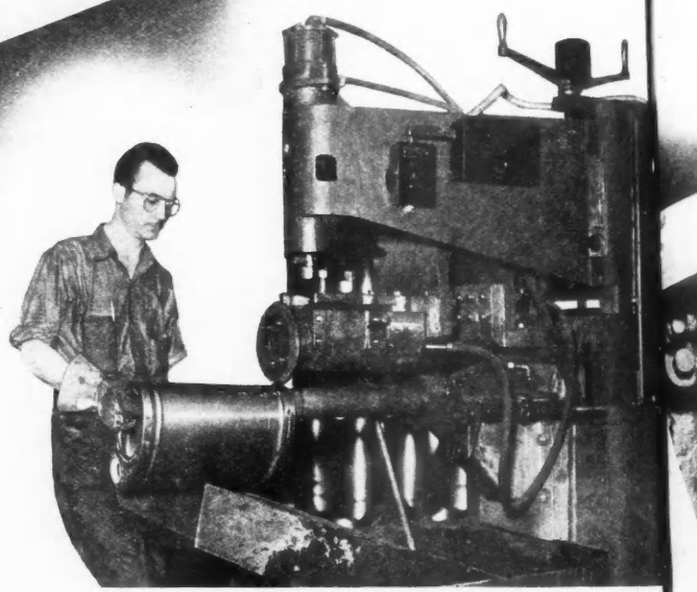
List of Production Departments

(Chicago Main Plant)

Automatic Screw Machine
Heavy Punch Press
Automatic Screw Machine (Multiple Spindle)
Milling and Hobbing
Automatic Separators
Grinding
Heat Treatment and Tumbling
Heading Machines
Welding
Plating and Dipping
Polishing and Sandblasting
Enameling
Light Punch Press
Screening and Glass Etching
Speedometer Assembly
Odometer Assembly
Panel and Gage Assembly
Raw Material Shearing
Electric Gage Assembly
Electric Fuel Pump and Car Heater Assembly
Flexible Shaft
Hand Compressor and Hose Assembly
Fitting Assembly and Light Machinery
Hand Screw Machine
Alemite Service Equipment Assembly
Coil and Condenser Manufacturing
Automatic Parts Inspection
Dies and Gages



(Left) Here is the odometer dial automatic spraying conveyor with spray gun located at the center, spraying across into the ventilated hood



(Right) Seam welding of the base to the shell of a tractor bucket is accomplished on this 200 KVA Thomson-Gibb resistance welding machine at the rate of 70 pieces per hour

tion, there is a new line for the assembly of the unique electric speedometer recently made available. A typical speedometer assembly consists essentially of a group of sub-assemblies and component parts, the sub-assemblies being built up at stations which, in proper sequence, make up the assembly line.

Briefly, the sub dial and pointer are fitted to the mechanism and this, in turn, is fastened to the case. The reset shaft knob, set screw and nut then are installed and the sub-assembly tested in the reset checking fixture. Finally, the glass, retainer, and bezel are applied.

At this stage of assembly the instruments enter a sound-proofed booth where each individual unit is subjected to a test for quietness of operation in the "silent" test fixture. Sound quality is judged entirely by ear since many years of experience have shown that a trained ear is the most reliable criterion of customer acceptance. Following this is another basic inspection, that of speed calibration. For this purpose, each instrument is tested in a special calibrating machine having four speed-range spindles which check four arbitrary points on the speedometer scale. When the instrument passes this inspection the trip and season odometer are set back to zero and the date of assembly is stamped on the back.

The housing for the South Wind car heater is made in an ingenious manner promoting good cost economy. In the first place, the punch press operations are designed to produce a single closed shell which makes up two separate housings when cut apart. In preparation for this the large blank is trimmed at the four corners and is drawn to the required form in three punch press operations, then bumped and trimmed.

The shell is parted into two separate housings in a series of three successive operations. Each housing assembly is made up by spot welding the various small fittings, finished by spraying the exterior. Then the ornament handle and grille are assembled in a punch press and the molding is riveted on. The housing now is ready for the final assembly line.

Assembly of the heater will be found to be one of the points of interest in this plant. The assembly line is compact and designed for efficient operation, particularly at the stations for making up the small core

and the fitting of the electric igniter elements. Upon leaving the assembly line, the heaters are suspended on an overhead monorail conveyor and are transported to the final inspection department.

We cite this as an outstanding example of the quality control impressed on all Stewart-Warner products. Here will be found a large battery of test stands, providing facilities for checking each heater for four hours on a schedule simulating actual operating conditions in an automobile. This is precisely analogous to the block testing of engines and the schedule is as carefully controlled and checked by scientific instrumentation.

In a similar manner, a visit to the auto radio department will reveal a suitable assembly department with sub-assembly stations and a final assembly line, with calibrations and inspection at certain key points. Each finished unit must pass muster in a soundproofed booth where it is thoroughly checked for tone quality and sensitivity by a competent radio inspector.

The electric windshield wiper is a relatively new accessory item for this company. It, too, is housed in a specialized assembly department where each detail of the unit is carefully prepared and inspected. To assure consumer acceptance, each instrument is checked for motor and gear noise, by a trained ear, in a soundproofed booth where the unit is connected up and run under power.

In a similar fashion, the assembly lines for other instruments, heat indicators, fuel gages, instrument panel assemblies, and the like, all are provided with special calibration and checking devices to assure quality control.

In retrospect, it is obvious that the technical character of the product imposes a great responsibility upon development and engineering—and both are found in generous measure. The laboratory facilities include electric cradle dyanamometers for testing the various instruments directly on production engines, simulating actual operating conditions; refrigerated cabinets for the low-temperature testing of car heaters

Automotive Products Manufactured By Stewart-Warner Units

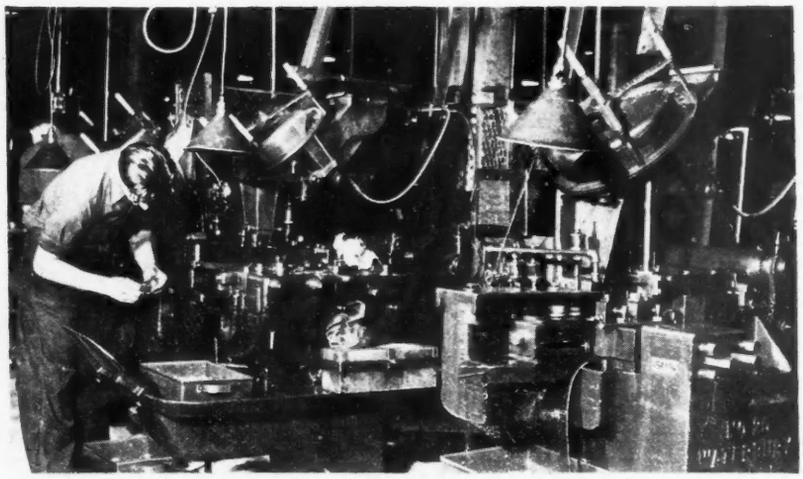
STEWART-WARNER CORPORATION
- Radios (auto)
- Car Heaters
- Speedometers (Electrical & Mechanical)
- Gages (Oil-Heat-Gas-Amp.)
- Panels
- Tank Units
- Fuel Filters
- Hour Meters
- Fuel Pumps
- Tachometer
- Windshield Wipers
- Alemite Fittings
- Shafts
- Gears (transmission)
- Gears (oil pump)
- Vacuum Tanks

STEWART DIE CASTING DIVISION
- Die Castings

BASSICK COMPANY
- Automobile Hardware

(Above) Alemite threaded drive fittings are being automatically assembled in this number 18 Bliss dial feed punch press

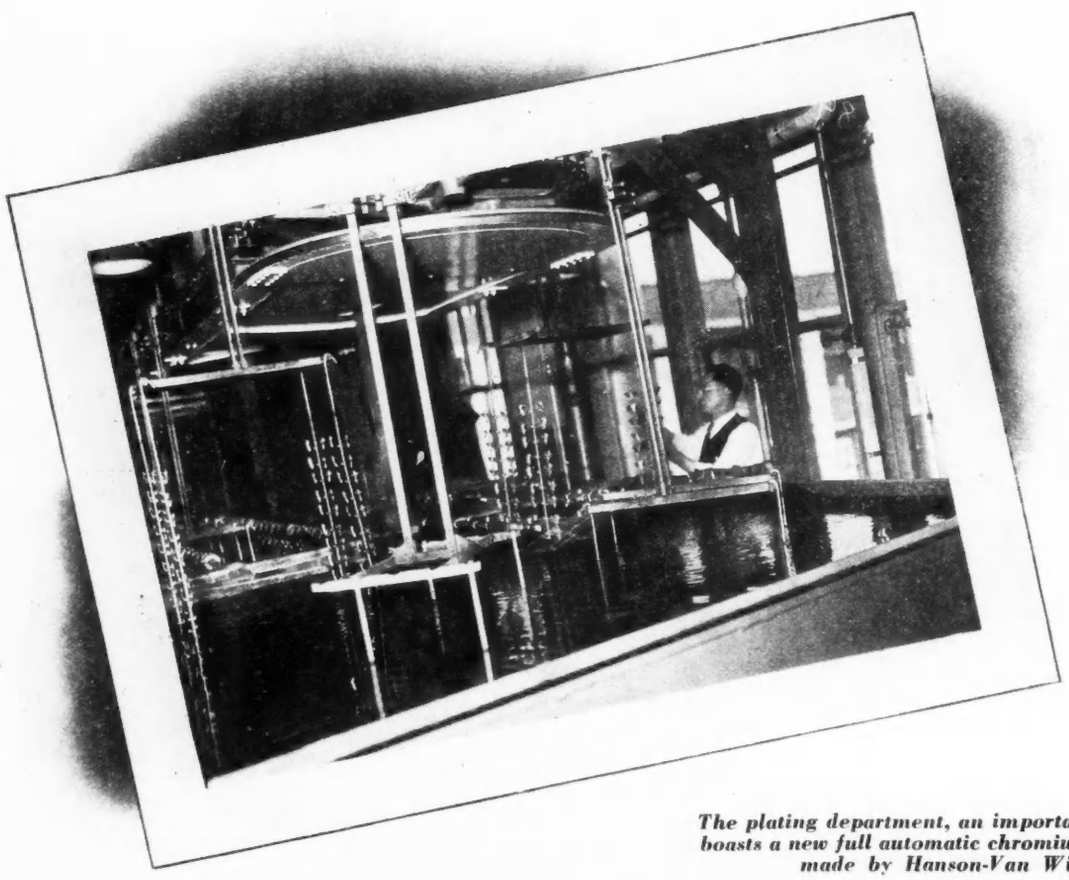
(Right) Odometer dials are coined from aluminum slugs on this 100-ton Toledo press



After heading, the Alemite fitting body is threaded in a Waterbury-Farrell thread rolling machine

and other devices; chemical laboratories; and other accessory facilities. Many of the original ideas for new products or improved products and much of the refinement in existing devices may be credited to the activity of a large sales engineering organization quartered in Detroit, conveniently located with respect to the majority of the company's customers.

One of the important technical processes in this plant is that of painting glass for radio, speedometers, and other instruments. The glass, first, is washed in chemical baths and rinsed to present a chemically clean surface. For painting they have developed a method of preparing stencils by blocking out photographically all of the surface of a piece of fine imported bolting silk, excepting the pattern of the inscription for the dial. This silk screen is stretched taut over a wooden frame and is laid over the glass. A rubber squeegee draws the paint over the stencil, penetrating through the open pattern of the screen. For multicolor inscriptions, the process is repeated, once for each color.



The plating department, an important activity in this plant, boasts a new full automatic chromium plating conveyor unit made by Hanson-Van Winkle-Munning

AUTOMOTIVE INDUSTRIES

Just among Ourselves

THERE is little doubt that the chief reason for the rapid adoption of pneumatic tires for farm tractors in recent years is to be found in the comfort which they afford the operator. The pneumatic, however, has another advantage, and that is that it greatly reduces the amount of power required to move the tractor itself over the field, in spite of the fact that with these tires it is usual to add dead weight (cast iron masses on the wheels and water in the tires) in the approximate proportion of 40 per cent, in order to make it possible to obtain sufficient traction.

Years ago, when steel wheels with driving lugs of one form or another were common equipment on farm tractors, and when these tractors were still being rated by their manufacturers, the maximum available drawbar horsepower usually was about two-thirds the maximum belt horsepower, and ratings of 20-30 and 24-36 hp. were common. In recent years the efficiency of steel-wheeled tractors has increased somewhat and the average ratio of maximum drawbar to maximum belt horsepower of five such tractors tested at the University of Nebraska in 1936 was 72.5 per cent.

The engine, of course, produces substantially the same maximum horsepower whether the power is taken off by belt or whether it is used to move the tractor and load over the field, and the difference between drawbar and belt horsepower is accounted for mainly by the power required to move the tractor itself and by power wasted in wheel slippage.

Recent reports of official tests on pneumatic-tired tractors show a much closer approach of the maximum drawbar to the maximum belt horsepower. For five such tractors the average ratio of drawbar to belt horsepower was 88.5 per cent.

In the Nebraska tests the wheel slippage is determined, and it is, therefore, possible to calculate the horsepower lost as a result of such slippage. From the remainder of the loss and the weight and speed of the tractor in the test, the coefficient of rolling resistance can be figured. This averaged 30 lb. per 1000 for the five pneumatic-tired tractors and 155 lb. per 1000 for the five steel-wheeled tractors. For motor vehicles on hard, smooth, level road the coefficient of rolling resistance is only about 15 lb. per 1000, or about one-tenth that of the steel-wheeled farm tractor.

Truck-Gradeability Requirements

For the past three years there has been an agitation for a legal minimum gradeability requirement for motor trucks and tractor-trailer combinations.

In a report on the general subject of highway safety, submitted to Congress, in 1937 by the Bureau of Public Roads, it was pointed out that the hill-climbing ability of many freight vehicles left much to be desired, and the suggestions were made that the performance ability of the vehicles should be exactly defined by their manufacturers and that legislation should be adopted requiring the vehicles to be operated in such a way as to not impair their performance ability.

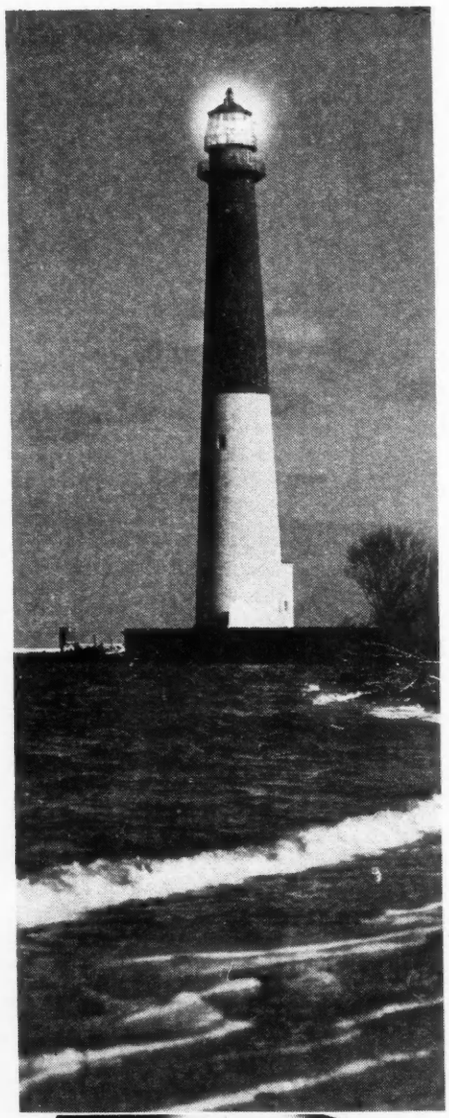
Any requirement of a minimum gradeability necessarily must be in such a form that compliance with it can be easily checked at almost any point of the public highways. It would evidently be impractical, if a vehicle were suspected of carrying excessive load, to order the driver to some remote test hill and instruct him to ascend the hill as fast as possible. Equally impractical would be the installation of a chassis dynamometer at the road side.

The subject has been under consideration by the Motor Truck Rating Committee of the S.A.E., and a report containing nine recommendations has just been made by this committee. At one time it was suggested that the minimum performance requirement be set at a speed of 20 m.p.h. up a grade of 4 per cent. The Rating Committee, however, holds that the object is to ensure reasonable speeds on all grades, hence the requirement should not be tied to a minimum speed up any particular grade. It is suggested that if legal minimum performance requirements are adopted, each freight vehicle be licensed to operate at gross vehicle weights not exceeding a certain maximum, and that this minimum g.v.w. should be made a certain multiple of the net horsepower which the engine is capable of delivering at the clutch. This net horsepower is to be determined from a curve which the manufacturer should be required to supply.

Just what the minimum ability of trucks and combinations should be is a problem that comes within the province of highway authorities rather than that of automobile engineers, and the Rating Committee, therefore, wisely confined itself to pointing out what seems to be the most practical method of approaching the problem, rather than suggesting a definite minimum requirement.

If the plan proposed by the Committee is adopted by the various state legislatures, each legislature will set a definite limit on the permissible gross weight per horsepower delivered at the clutch. This, in connection with the certified horsepower curve to be furnished by the manufacturer, will establish the maximum permissible gross vehicle weight for any given vehicle, and a simple weighing operation, which can be carried out on the road or at the road side, will determine whether the vehicle is being operated in accordance with the law with respect to "ability."

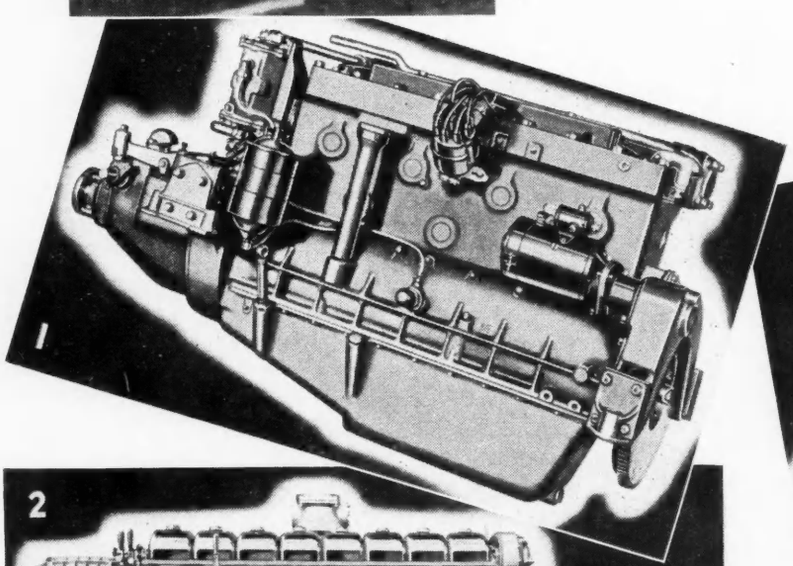
—P. M. H.

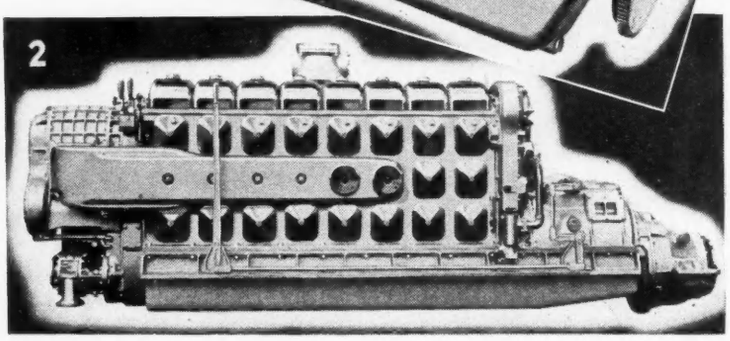


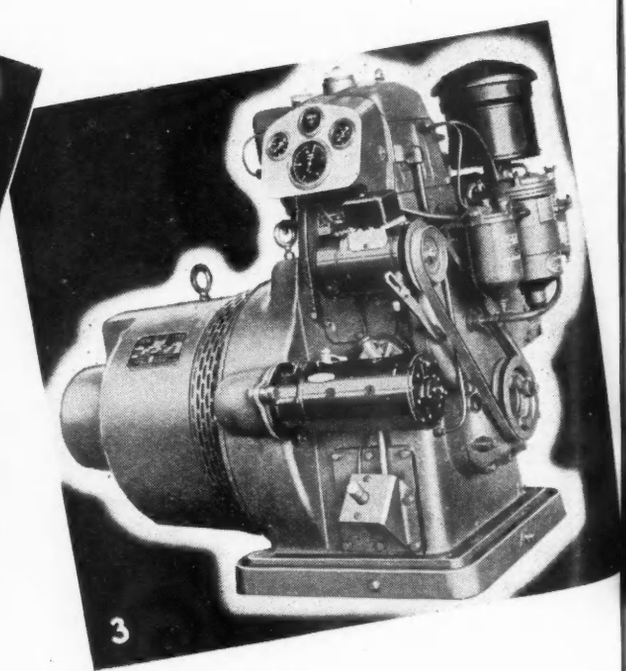
The Motor Boat Show

ELEVEN of the 31 engine exhibitors at the 35th Annual Motor Boat Show in Grand Central Palace, Jan. 5 to 13, were automotive companies; 15 engine makers offered Diesels, more than doubling last year's number of makes with a total of 43 Diesel propulsion engines, and more than a score of Diesel-electric generating plants. Only General Motors and the Gray Marine Motors, converted G. M. units as well as their augmented line of converted gasoline engines, were of the two-cycle type.

Generally, the engines shown this year marked a trend toward fresh water, dual, or closed system cooling. This type of heat exchanger overcomes salt caking of the water jackets and corrosion of ocean water, and permits the use of anti-freeze in cold weather operation.







Engines showed an increased use of oil coolers. Engine speeds have been reduced in many designs, permitting the use of propellers of larger diameters for increased propulsion efficiency. Some engine makers offered lighter units for smaller craft.

Boats shown ranged from six ft. long to the giant of the show, the Elco 57-footer, powered with two G. M. 165-hp. Diesels, listed at $37,895.

Championship models of sailboats of several classes, outboard motorboats, hydroplanes, and the luxurious cabin cruisers vied with each other for attention. More than 6500 people went aboard the big Elco every day of the show, and waiting lines stood in patient cues.

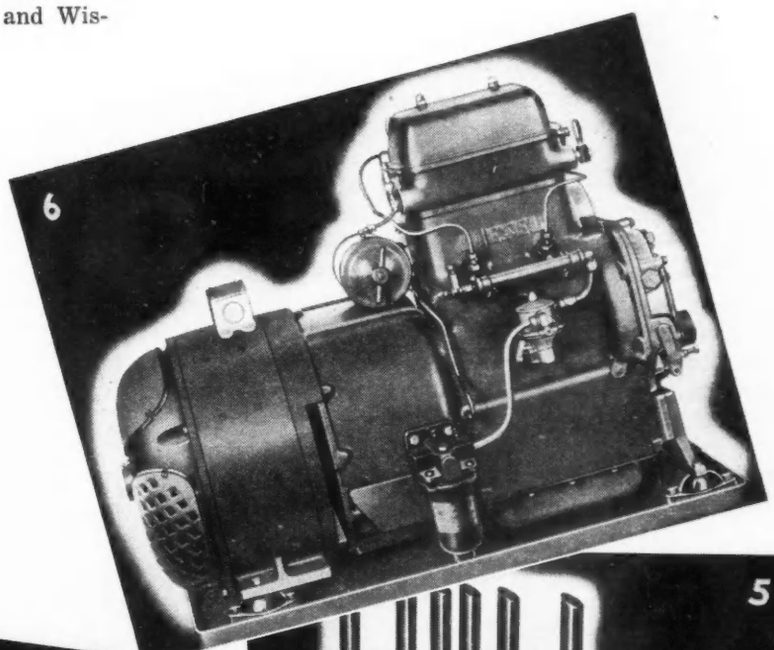
Among the old-line marine engine builders in the show, 10 have been exhibiting for more than 20 years. Automotive engine builders, some of who have been in the marine field for many years, were The Buda Co., Caterpillar Tractor Co., Chrysler Corp., Cleveland Diesel division of G. M., formerly the Winton Engine Co., Cummins Engine Co., Gray, Kermath, Mack Mfg. Corp. with its recently announced marine Diesel in two models, Scripps Motor Co., Waukesha, and Wisconsin Motor Co.

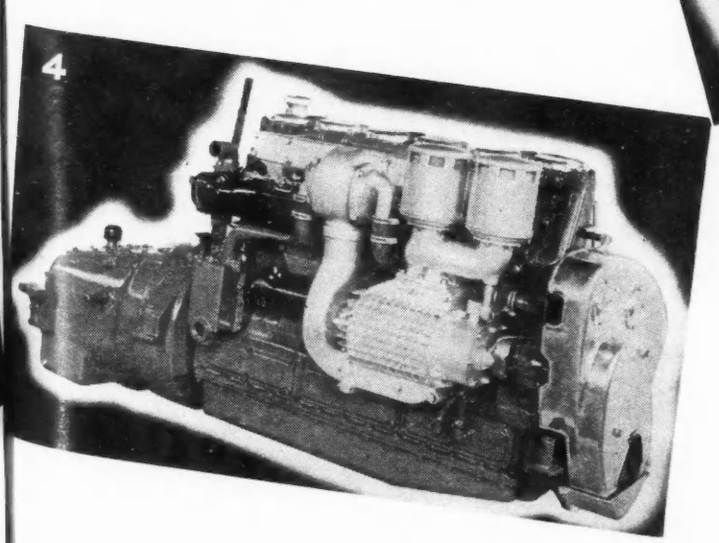
Sterling's disc-crank announced several years ago has been so widely accepted that they did not resort to their working model of the device this year. Navy, Coast Guard, tugboat, and fireboat acceptance has been achieved by this engine.

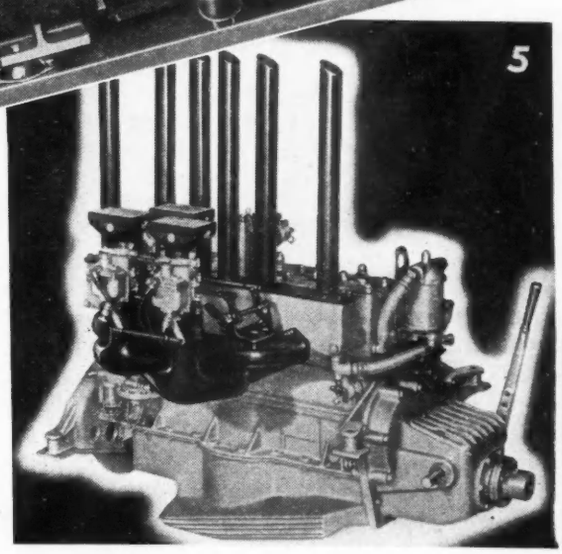
Firms manufacturing both gasoline and Diesel powerplants reported that the buying-public's interest centered in the compression-ignition units. Atlas Diesel Engine Corp., Oakland, Calif., showed four of its engines, the largest being its 135 hp. at 900 r.p.m. unit. It has six 6½ by 8½ in. cylinders, and has been redesigned for easier starting and quieter operation. The big "Imperial" was flanked by three smaller engines, one a three-cylinder, 15-hp. powerplant. The company also showed its line of Diesel generators, the smallest shown being a 3 kw. unit powered by a single cylinder Atlas Lanova.

Briggs & Stratton Corp., Milwaukee, showed gasoline inboard and auxiliary engines, all air-cooled. All

(*Turn to page* 134, *please*)







1. Chrysler Royal Eight develops 76 to 143 b.hp. at 1600 to 3200 r.p.m.

2. General Motors Eight-in-Line two-cycle Special marine Diesel

3. One-cylinder, 10 kw. General Motors two-cycle Diesel Marine auxiliary generating set

4. Manifold side of the Supercharged 200 hp. Cummins Diesel

5. 1940 Gray Racing Fireball of 180 hp. at 5000 r.p.m.

6. United States Motors Corp. Two-cylinder Marine Diesel electric plant

SAE Annual Meeting Draws

(*Continued from page* 92)

creasing the cranking speed or by increasing the amount of heat supplied to the incoming air. The diagram herewith shows the effects of these two factors (cranking speed and rate of heat supply to a 500-cu. in. engine) on the starting time, for atmospheric temperatures of 0 deg. and 17 deg. Fahr. respectively. It will be seen that at zero deg. Fahr. there is little advantage in supplying heat at a greater rate than 8 watts per cu. in. displacement, regardless of the cranking speed, because the curve becomes quite flat beyond this point. With an increase in atmospheric temperature the rate of heat supply required decreases quite rapidly, and at 28 deg. Fahr. atmospheric temperature most engines require no external heat supply to make them start. By means of a blow torch inserted in the air inlet, satisfactory starts could be made at zero deg. atmospheric temperature with a heat input equivalent to 2300 watts. That it should take less heat from a blow torch than from an electric heater is explained by assuming that in the former case there is an extremely hot core of air, and less heat is lost to the walls.

In selecting a starting motor, the vehicle manufacturer often makes the mistake of choosing one that is really too small. He makes this selection in the expectation of saving money, but the small motor will crank the engine at a low speed, and this increases the cranking time, with the result that the amount of electrical energy consumed in starting is increased, and a larger and more expensive battery is needed to supply this energy.

The size of battery required for satisfactory starting depends upon the lowest temperature under which the engine may have to operate in the particular locality, and the authors said it was their practice to specify a battery which when fully charged will crank the engine for 1½ min. at the lowest operating temperature expected under given conditions. When half charged, such a battery would crank the engine for 40 to 45 sec.

Pressure Distribution on Engine Cowls

RAPID progress has been made in the development of low-drag cowling for radial air-cooled aircraft engines during the past several years, and many of the drag and cooling problems involved have been solved by research and experimentation. But little attention has been paid so far to the problem of strength requirements, and this subject was dealt with in a lengthy paper by R. R. Higginbotham, powerplant-installation engineer of Republic Aviation Corporation. The strength requirements, of course, depend on the air pressure on the cowling, and the paper included numerous tables and graphs showing the pressure distribution over the surface of the cowl.

Wind-Tunnel and Flight-Test Results

IN THE PAST five years competition in the aircraft field has become very keen, and at present the placing of large contracts involving between one and fifteen million dollars may depend solely on the guarantee that a company is willing to make. Accurate coordination of wind-tunnel test results and results in actual flight is the only available method of accurately predicting the performance of a new design. The wind-tunnel results alone do not fully determine the actual performance in free flight; other variables that must be considered are the Reynolds number, turbulence, surface conditions, miscellaneous added protuberances, slipstream, propeller, engine power, and engine-cooling drag. Each of these factors presents a problem in itself, said W. W. Symington, Jr., The Glenn L. Martin Company, in a paper on the subject, but in a general analysis they, with the wind-tunnel results, can be combined into three separate major variables, viz., engine power, propeller, and drag. The

Fifty speakers stood behind desks like these at the five-day annual meeting of the S.A.E. Typical picture shows Errol Gay, Ethyl Gasoline Corp., in the middle of a paper on instrumentation as it applies to motor vehicle fleet operation.

s Thousand Members

Showmanship distinguishes the general-interest sessions arranged by the Detroit Section at recent S.A.E. annual meetings. This year a GE magician demonstrated lamps: hot and cold, smallest and largest.

engine power and propeller efficiency are important as a means of measuring the flight-test drag. Any one of these three variables may be adjusted after a flight test to arrive at the correct result. The real problem, however, is to predict the performance, and this can be done correctly only if the power, propeller efficiency and drag used in the calculations are the same as the corresponding values obtaining in the flight test after the plane has been built.

Developments in Lighting

ON MONDAY evening, at a session sponsored by the Detroit Section, a representative of General Electric Company spoke on and gave demonstrations of "Recent Developments in Light and Lighting." Models were shown of the incandescent lamp in its various stages of development, and the speaker also exhibited a new high intensity mercury arc lamp, a new 48-in. fluorescent lamp giving daylight-quality light, which has found application in industrial lighting; a new, small photoflash lamp, and a luminescent fluid emittting "cold light". The use of incandescent lamps for the quick drying of paint and lacquer was also referred to.

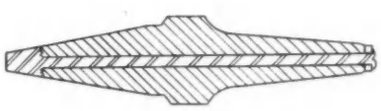
Ceramic Spark Plugs for Aircraft Engines

A RATHER unusual session was that devoted to spark plugs for aircraft engines. As a rule, when some automotive product is discussed before an S.A.E. audience, it is extolled and shown in its best light by the speakers, but at this session the modern aircraft spark plug was subjected to severe criticism and practically nothing was said in its favor. It appeared that what had led to the scheduling of this symposium was the unhappy experience of air lines with spark plugs in recent years. In the discussion it was brought out that United Air Lines spends more for spark plugs than for oil in a given time. As most of the criticism was leveled at the currently-predominent mica-insulated type of plug and the different authors saw relief from present difficulties in the adoption of improved types of plug with ceramic insulators, it was expected that the discussion would lead to a heated debate between the protagonists of the different types, but no discussion of this character materialized.

In recent years mica-insulated spark plugs have been used almost universally for aircraft engines, apparently because these were better able to withstand the high thermal, electrical and mechanical stresses to which plugs are subjected in such engines. But according to A. L. Beall, research engineer of the Wright Aeronautical Corporation, no major improvements have been made in mica-insulated plugs during the past three years, and it appears that the limit of the possibilities with this material has been practically reached.

A ceramic insulator is the logical choice as a substitute for mica (the author said), because it may have most of the desirable di-electric characteristics of mica and at the same time have a dense homogeneous structure in contact with the combustion gases. If the insulator is well designed, thermal expansion of the center electrode does not necessarily present serious difficulties.

Among the advantages which might accrue from the use of ceramic materials for spark plug insulators is that of a reduction in weight. With 18 cylinders the total weight of the heaviest spark plugs used (two plugs per cylinder) amounts to 4.86 lb. per engine, whereas with a certain 10-mm. ceramic-insulated plug, integrally shielded, which is now under test, the weight is only 1.26 lb. for the same engine. For an air-cooled engine the reduction in the vertical fin area on the cylinder head to accommodate the spark plug is much less for a 10-mm. than for an 18-mm. plug.



Representative core assembly of ceramic spark plug

Ceramic-insulator spark plugs for aircraft engines are not new, but the development of such plugs for a time was outstripped by engine requirements for a

wide heat range, radio shielding, and resistance to lead fouling. Recent experience indicates that these requirements can be met and other advantages gained with well-designed ceramic plugs. These usually give greater freedom from preignition, and the author thought this might be due to a better seal against gas leakage and to the fact that the ceramic insulator reflects radiant heat instead of transmitting it.

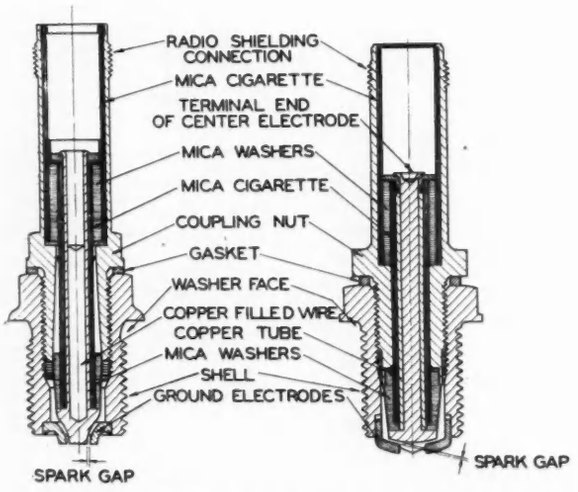
The British were the first to return to ceramic insulators for spark plugs, and a British plug of this type leads the way, according to the author. There are now two designs of modern ceramic-insulated spark plugs for aircraft engines, and both use a bulky core insulator of the general type shown by the sketch, with the central electrode molded in place. A shoulder or taper above and below the maximum diameter seats directly on the shell or on a suitably-shaped internal gasket. The insulating material in these spark plugs is described as consisting of sintered aluminum oxide. It is a chalky-white material and not particularly brittle.

Aircraft Spark Plugs

VAL CRONSTEDT, research engineer of Pratt & Whitney Aircraft Division, United Aircraft Corporation, dealt with "The Shortcomings of Mica as an Insulating Material for Aviation Spark Plugs." He said that in American air transport, between 80 and 90 per cent of delays caused by the engine itself have their sources in ignition troubles. The igniting system may be divided into three parts, viz., the magnetos with their mountings and drives, the wiring system, and the spark plugs. The spark plug is the place where any ignition trouble first shows up, by its failure to ignite the charge, and it is very likely that the blame is often put on the spark plug when the fault really lies with some other part of the system.

Sectional views of two typical mica-insulated spark plugs used on American aircraft engines are shown by the drawings.

One disadvantage of mica as a spark-plug insulator is its low heat conductivity, as a result of which a plug may be so cold that under idling conditions oil, gasoline, moisture and current-conducting deposits accumulate on the insulator and short-circuit the plug, while under full load it may be so hot that the materials are destroyed.



Sectional views of two typical mica-insulated spark plugs for aircraft engines.

All mica contains water in chemical combination. At 1000 to 1200 deg. Fahr. this water is driven off (the mica is dehydrated) and this results in rapid destruction of the plug. The material generally expands greatly, becoming brittle, white and powdery, and in this state it cannot withstand the mechanical stresses to which it is subjected.

In order to keep down the maximum temperature of the nose of the central electrode, plug manufacturers have reduced the thickness of the mica tube (or cigarette) to facilitate heat flow, but this makes the cigarette more fragile and it also increases the electrical capacity of the secondary circuit. Another disadvantage of mica is that its thermal expansion is less than half that of the stainless steel of the central electrode, which tends to loosen the washers at high engine temperatures, allowing carbon, oil, etc., to lodge between them. The affinity of mica for moisture is another disadvantage, and in order to prevent this from causing trouble, mica plugs often are stored in special heated cabinets.

Mica is a silicate and many silicates react vigorously with litharge which may be formed on the exposed surface of the mica insulator by the oxidation of lead bromide deposited thereon by the combustion of "leaded" fuels.

Any deposits of lead silicate thus formed on the insulator greatly change the thermal properties of the plug.

Ceramic Spark-Plug Insulators

THE FIRST ceramic insulators were made of porcelain, which consists essentially of clay, quartz and feldspar, said Frank H. Riddle, director of research of the Champion Spark Plug Company, in a paper on Ceramic Insulators for Spark Plugs. The well-known hard tableware of Europe, for instance, consists of 50 per cent clay, 25 per cent quartz, and 25 per cent feldspar. Articles are molded from this mixture and after being dried and fired at a sufficiently high temperature, they assume the familiar vitreous, translucent character.

The clay is the plastic agent which permits the wet mixture to be molded and shaped. The quartz produces the rigid skeleton which lowers both the drying and firing shrinkage and imparts to the mass the necessary resistance to distortion at the high temperatures which are involved. The feldspar functions as the glassy cement which unites the whole to form a vitrified structure that approaches zero porosity and produces a certain degree of translucency to light.

From these feldspatic porcelains the present spark-plug insulators have been developed. About 1918 the manufacturers became cognizant of at least two basic defects of ordinary porcelains. One was the tendency of quartz to invert to its different crystalline modifications, with resulting volume changes which cause stresses to be produced within the porcelain structure. The other was the electrolytic conductance of the

feldspar at higher temperatures, which reduced the insulating efficiency of the material.

To overcome these defects, the quartz was replaced by inert components like mullite (previously known as sillimanite) by the introduction of minerals of the sillimanite group, all of which correspond to the formula Al_2O_3 SiO_2. Likewise the feldspar was replaced by other fluxes, like the oxides of magnesium and calcium. Improvements were carried still further by the insistence upon fine grinding and the employment of high temperatures which made it possible to reduce the volume of the glassy matrix in the insulator to a minimum. Strict inspection methods and control were initiated.

The results of these changes were striking, and in 1931 Kraner and Snyder of the Westinghouse organization felt justified in making the statement that "American spark-plug porcelains of the mullite type are vastly superior to all other ceramic materials, as to mechanical strength, thermal shock resistance, and glaze fit."

Among the properties of a ceramic material upon which its value as a spark-plug insulator depends the following are of importance: Density, porosity, refractoriness, mechanical strength, thermal expansion, electrical resistance, thermal conductivity, resistance to heat shock and resistance to chemical agencies.

Multi-Stop Vehicles

A PAPER on "Multi-Stop Delivery Vehicles" was presented by Ralph Werner of United Parcel Service, who emphasized the importance of designing such vehicles for economical operation. In business devoted to inexpensive commodities, such as milk or bakery goods, the delivery cost may be equal to many times the profit, and a saving of 10 per cent on delivery costs may possibly double the profits. Formerly the running cost of the vehicle per mile was considered the all-important item by many operators, but it is now realized that many cost items, such as labor, insurance, license, and storage, are the same for all vehicles of the same nominal rating, and that the efficiency of the vehicle in delivery work is therefore highly important. The "pie-type" diagram reproduced herewith shows a breakdown of the costs of multi-stop delivery.

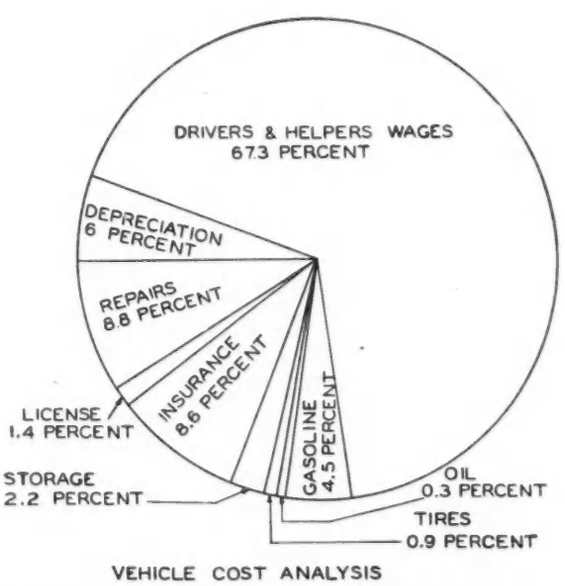


Diagram to show the breakdown of the cost of multi-stop delivery.

In order to keep down the fuel consumption and also to save the transmission and final drive, these multi-stop vehicles must be designed for moderate performance. Weight distribution should be such that there is considerably more than 50 per cent on the rear tires under full load, as otherwise the traction with the vehicle empty will be inadequate, and excessive rear-tire wear may result, depending on how the driver handles the vehicle. In department-store delivery much time can be saved in picking out packages in the body by providing full headroom and an abundance of space. A seat used in vehicles of the Delivery Vehicle Company, which is 30 in. above the floor, allows the driver to slide onto it practically without stooping, and it is also very easy to get out of.

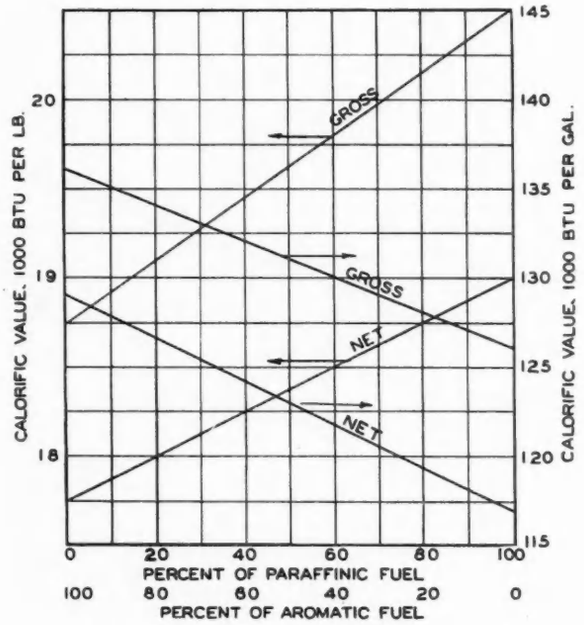
Sliding or folding doors are best for the sides, and doors sliding either sideward or up and down have advantages also for the rear. Controls that can be operated by the driver whether sitting or standing are best for this type of vehicle.

Safety Fuels for Aviation

IN A paper by Robert E. Ellis and William J. Sweeney of Standard Oil Development Company it was stated that the use of relatively non-volatile gasolines in aircraft engines for the purpose of reducing fire hazards was proposed by Ferrier in France in 1926. Reduction to practice, however, was strongly handicapped by the low anti-knock value of such fuels then available. Some three years later the Standard Oil Development Company succeeded in preparing a high anti-knock hydrogenated safety fuel of aromatic type and proposed its use in aircraft engines. The U. S. Navy was first to seriously consider the use of such fuel, the probable reason being that it had substituted helium for the inflammable hydrogen in large airships and that the use of safety fuels would have further reduced the fire hazards materially. However, the use of large airships was curtailed some years later, and this led to a decrease in interest in these fuels.

There are two possibilities for safety fuels of high octane number. The aromatic type can be produced by solvent extraction from selected crudes. Supplies of material of this type can be augmented by thermal and catalytic reforming, dehydrogenation, destructive hydrogenation, catalytic cracking and vapor-phase cracking. The paraffinic type of suitable octane number is not available in any presently-known crude oils. Therefore, paraffinic safety fuels will of necessity be 100 per cent synthetic products, the same as the blending agents now used in aviation gasoline, such as iso-octane, hydrocodimer, alkylate, and neohexane.

One of the principal differences between safety fuels of the aromatic and paraffinic type relates to their calorific values. In the extreme, the difference in the net calorific value per pound can be as high as 6 or 7 per cent in favor of the paraffinic type fuel. On the



Calorific value of safety fuels for aviation.

other hand, the net difference of the calorific value per gallon can be as high as 8 or 9 per cent in favor of the aromatic type fuel. The diagram shows the relation between the gross and net heat values of representative aromatic and paraffinic safety fuels or blends thereof, both on a pound and a gallon basis.

The authors concluded that safety fuels can be made available in very substantial quantities, and that prices will depend on the specifications finally adopted, and on the consumer demand. It is reasonable to expect that the cost trend will be the same as for aviation gasoline of equal octane value, provided specifications are not too restrictive and a substantially similar consumer demand develops.

Safety Fuel by Alkylation

RAYMOND HASKELL of the Texas Company described the process of making safety fuels by alkylation. Alkylation essentially is a chemical process whereby an alkyl radical is substituted for a hydrogen atom in a hydrocarbon molecule. More specifically "alkylation" describes a process whereby certain definite types of hydrocarbons containing alkyl side chains are formed by the interaction of two or more hydrocarbons of a rather specific nature. The discovery of the process was the result of attempts to make iso-octane, a paraffin hydrocarbon of high anti-knock value, synthetically.

Iso-paraffins and olefins (such as iso-butane and butylene) can be made to react with each other by the application of either heat or pressure, or by the use of a catalyst. Only the catalytic processes, which generally use the heavier olefins, give products of high anti-knock value suitable for aircraft safety fuel, the most widely used catalyst being sulfuric acid.

As regards the state of commercial development, the author said there is now in operation, under construction or seriously contemplated, sufficient capacity to make 15,000 barrels per day. Naturally, there is no limit to the number of production units which can be installed, and if the raw materials should give out there are known ways of making them. Olefins can be produced by cracking, and iso-paraffins can be made by isomerization of normal paraffins. As to the probable price of the product, the author assured his audience that it would be within reason, and that as soon as some reasonably definite figure of demand for the next five years could be determined, competition would bring the price to a level which the aviation industry could afford to pay.

Safety Fuel of Aromatic Type

ANOTHER safety fuel, of the partially aromatic type produced by cracking, was dealt with in a paper by W. M. Holaday. He said that with the introduction of the catalytic cracking method during the past few years, a method is now available for the production of aromatic-type safety fuels on a large scale. Using this base and adding 3 c.c. tetra-ethyl lead per gallon, one obtains fuels having an octane number in excess of 85, and by blending with paraffinic type safety fuels and tetra-ethyl lead, higher octane numbers may be had. The author stated that, using equipment at present in operation, with slight modifications for distillation and separation of the product, over four million barrels of the base stock could be produced per year. This supply alone would take care of an unprecedented aircraft expansion program. Safety fuels produced by catalytic cracking and distillation only, without further processing (such as solvent extraction, acid-treating, etc.) contain about 30 per cent aromatics. One such fuel has a distillation range of 330-397 deg. Fahr. and a (higher) heat value of 19,860 B.t.u. per pound. No definite information as to costs was given.

Varnish and Sludge

A SURVEY of recent findings and current opinion as to the causes of varnish and sludge formation in engines, made on behalf of the Passenger-Car Activity, was presented by F. F. Kishline. A list of sixteen questions was sent to eighteen manufacturers, and their answers to the various questions were given in the report. To the question as to what the industry should do to get out of varnish and sludge trouble, or if they felt it was an oil problem, what the oil companies should do about it, most of the manufacturers replied they thought it was an oil problem. The most definite recommendations were that warming-up periods be reduced, that engines be kept at operating temperatures while standing over night, and that no breathers and filler tubes be used that act as condensers; also, that investigations be made as to why some oils sludge much more badly than others, some fuels form lacquer more rapidly than others, what are the sludging characteristics of straight-cut and blended oils, and what may be achieved by means of inhibitors in the oil.

Axle and Transmission Lubrication

A PAPER by William S. James of Studebaker Corporation contained a great deal of information on present practices and trends in the lubrication of transmissions and rear axles. During the past ten

years most car makers have recommended two or more seasonal changes for axle and transmission lubricant, but this practice has changed and three or more changes of lubricant per year are no longer recommended. The most important development of recent years affecting lubricating practice has been the adoption of hypoid-gear rear-axle drives.

The temperatures, pressures and rubbing speeds in gearing are probably the most important factors in the selection of suitable lubricants. In the case of one manufacturer the load per inch of face width of the intermediate and low-speed gear increased considerably during the past decade. Demands made on transmission lubricants increase with the temperature reached by the lubricant in service, and the author gave a table of equilibrium transmission lubricant temperatures at car speeds of 50, 60, and 70 m.p.h. for eleven car models of current production. The maximum for the cars tested was 98 deg. Fahr. above air temperature. Another table showed the effects of lubricant viscosity and oil level in the case on the temperature reached by the oil. The heavier the oil and the greater the amount in the case the higher the "leveling-off" temperature.

Rear-axle-lubricant leveling-off temperatures also were given in tabular form, and it was observed by the author that the rise in temperature for an increase in speed from 60 to 70 m.p.h. was considerably greater in the case of the rear axle than in that of the transmission, and the maximum temperature of the rear-axle lubricant was 134 deg. above air temperature. In dealing with the subject of rear-axle lubrication the author made use of a new method of combining the effects of carrier stiffness and corrective gear cutting on tooth contact, which was described in the paper.

Seat Cushions

RELATIONS between the design of seat cushions and the riding qualities of a car were discussed by Clyde R. Paton, Edwin C. Picard and Vincent H. Hoehn of Packard Motor Car Co. They described and illustrated the different types of seat cushion construction and listed the advantages and disadvantages of each. In the view of the authors, cushion design, until recently, has never been accorded proper consideration in developing the riding qualities. Cushions were considered to come within the field of the trimmer's art. Chassis engineers who were primarily responsible for ride development did not understand cushions, and trim engineers responsible for the cushions did not understand the problems of riding quality. Actually cushion design involves scientific problems and should be approached from a scientific point of view.

Air Conditioning of Passenger Cars

HERBERT CHASE in a paper discussed present practice in ventilating, heating and cooling passenger cars. He divided the systems in use into four classes. Systems of the first class heat air which is recirculated through the car, ventilation being incidental. In the second system, part of the air passing through the heater is fresh air and part recirculated air. The third system takes all air passing through the heating unit from outside the car, while the fourth system, the most comprehensive, comprises means for heating and cooling the air and for ventilation. The majority of car heaters make use of the heat that passes into the water jacket of the engine, the cooling water being passed through a heater unit located under the dash or under the front seat, air being circulated through the air spaces of the core by a fan. There are, however, at least two makes of gasoline heaters on the market. Advantages claimed for these heaters are that they supply heat more quickly than the hot-water heater when the engine is cold, and that, since the gases of combustion keep the heating surfaces at a higher temperature than the water from the engine jacket, a smaller heater unit (core or coil) can be used. Disadvantages of this type are that a carburetor or its equivalent must be used, as well as an ignition device and piping for exhaust gases instead of for water. Whereas the hot-water heater uses waste heat, the gasoline heater consumes extra fuel, but this is said to amount to only about a gallon for 24 hours' continuous service.

Packard is now offering at extra cost for factory installation a system of summer and winter air-conditioning, by components furnished by the Bishop & Babcock Mfg. Co. This system is designed to filter the air and to circulate it through the car, adding only the fresh air that enters through leakage; to cool the air by mechanical refrigeration, with automatic dehumidification in summer, and to warm it in winter. The refrigerant used is "Freon," a non-toxic, non-corrosive, non-inflammable, non-irritating and almost odorless product which is in the gaseous state at normal temperatures. It is circulated through a closed system as in a household refrigerator. The compressor is driven directly from the engine and the refrigerating effect therefore is dependent on the car speed. At 25 m.p.h. it is said to be equal to 12,000 B.T.U. per hour and at 80 m.p.h. to 30,000 B.T.U. per hour.

Spot Welding of Body Steel

RESULTS of an investigation to determine the fundamental relationships between the various factors affecting the quality of spot welds in auto-body steel, conducted at Rensselaer Polytechnic Institute, Troy, N. Y., for the Welding Research Committee, formed the basis of a paper by Wendell F. Hess and Robert A. Wyant. To produce sound welds it is necessary to use the proper electrode pressure, amount of current, and electrodes of correct shape, size, and alignment; the current must be kept flowing the proper length of time, and the surface condition of the stock must be right. In the experimental work on body steel, copper-alloy electrodes were used, of 80 Rockwell B hardness, 85 per cent electrical conductivity, and 60,000 lb. per sq. in. yield point. When the welding current was kept on for six cycles, an electrode pressure of 15,000 lb. per sq. in. gave a notably more satisfactory weld than a pressure of 10,000 lb.; an increase to 20,000 lb., while it also gave strong welds, caused undesirable distortion and separation of the sheets due to extrusion of metal. One-quarter-inch flat electrode tips

were used. Welds were made also in which the current was kept on for twelve cycles. With an electrode pressure of 15,000 lb. per sq. in. the optimum current was found to be 11,000 amperes for 12 cycles and 12,500 amperes for six cycles. An interesting comparison was made between flat and domed tips. Less current is required with domed tips to produce good welds. When the stock was carefully degreased the welds showed slightly greater strength (from 1 to 3 per cent). This the authors considered of very little consequence and they concluded that if welds in oily stock showed low strength it was due not to the oil film but to dirt picked up by it.

Diesel Aircraft Engines

CONSIDERABLE data on new Diesel aircraft engines, either projected or built, were put forward in a paper by Paul H. Wilkinson. The engines covered included the Junkers Jumo 207, which is substantially identical with the well-known Jumo 205, except that it has two turbo superchargers and develops 1000 hp. for take off instead of 880 hp., this power being maintained up to 20,000 ft. This engine has a specific weight of 1.43 lb. per hp. and develops 131 lb. per sq. in. The fuel consumption is 0.35 lb. per hp-hr. at cruising output and it does not go beyond 0.38 lb. at maximum output.

Another recent German Diesel aircraft engine is a nine-cylinder liquid-cooled B.M.W. Lanova of 1690 cu. in. displacement which is rated 650 hp. at 2200 r.p.m. Including the cooling system the specific weight of this engine is 1.63 lb. per hp. and the b.m.e.p. 139 lb. per sq. in. There are six small radiators which are located between the cylinders, so as not to increase the forward projected area. A 14-cylinder B.M.W. Lanova of 1200 hp. maximum output at 2200 r.p.m. has been projected.

In France a 16-cylinder water-cooled Clerget Diesel has been completed under Government supervision recently. It is of the H type, its displacement is 4970 cu. in., and an output of more than 2000 hp. is expected from it at 2200 r.p.m.

Guiberson, who has been at work on aircraft Diesels in this country for many years, recently received an order of considerable magnitude from the War Department for air-cooled engines of similar design for use in tanks. The engines are to be built by Buda.

A comparison of the advantages of Diesel and carburetor-type aircraft engines was made in the paper, and the author concluded with a number of suggestions as to how the development of aircraft Diesel engines could be accelerated in this country.

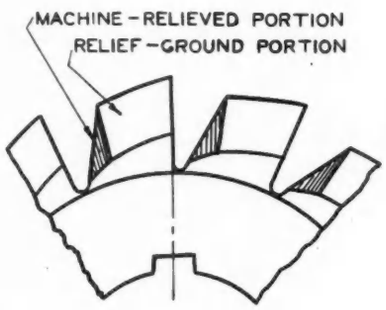
The Use of Plastics

AN INTERESTING paper on Plastics and Their Uses in the Automotive Industry was presented by Dr. Gordon M. Kline of the National Bureau of Standards. It traced the history of plastics in the United States over a period of seventy years and dealt with the various types that have been developed, giving their outstanding properties, the forms in which they are available, their methods of fabrication, and typical applications. This was followed by a list of trade names under which the particular type is being marketed and of companies manufacturing it. The latter part of the paper dealt with methods of molding. The development of presses for molding plastics was illustrated by numerous lantern slides, a movie of the plastic in industry was shown, and a collection of molded articles was exhibited.

Ground Form-Finishing of Gear Hobs

"QUIET GEARS" is the watchword of the transmission manufacturer of today, said Chas. R. Staub, chief engineer of Michigan Tool Company, in a paper on Ground Form-Finishing Hobs. Noisy gears always are found to be inaccurate, and how to manufacture accurate gears is the problem that confronts the gear manufacturer of today.

The machine-relieved hobs formerly universally used still suffice for many purposes, but not where silent operation, exact uniformity of rotation, or close fitting is stipulated. For such purposes, he said, relief-ground hobs should be used. They differ from machine-relieved hobs in that the flanks and tops of the teeth, and often the root as well, are ground after harden-



Hob with relief ground teeth

ing. This has the effect of eliminating all inaccuracies introduced by the hardening process, improving the lead, and ensuring uniformity of tooth form for all teeth.

Roughing as well as finishing hobs may be ground on the teeth, but form-grinding of teeth usually is limited to a special quality of work where high accuracy is required. It is not possible to lay down a rule as to where ground hobs must be used and where machine-relieved hobs will suffice. The deciding factor is the degree of accuracy needed. Thus, for example, many spline-shaft hobs are form-ground, although most hobs for special profiles are only machine-relieved, despite the fact that the short, wide spline-hob teeth distort very little in hardening, by comparison with other tooth forms. Hob teeth that are to be ground are relieved at the back to clear the run-out of the grinding wheel, as shown by the sketch. This leaves the hob tooth as strong as before, without widening the flutes.

Motor and Fuel Surveys

AT the request of the S.A.E. Fuels and Lubricants Division, J. B. Macauley, Jr., of Chrysler Corporation, had prepared a commentary on the two annual surveys which since 1936 have been sponsored by the Cooperative Fuel Research Committee—the C.F.R.

motor-gasoline survey, which is issued semi-annually by the U. S. Bureau of Mines, and the C.F.R. motor survey, which is issued by the Committee directly.

The first C.F.R. motor-gasoline survey, issued in 1936, presented data on gasoline samples collected in the winter of 1935-1936. Prior to that survey, the Bureau of Mines had conducted, of its own initiative, a series of similar surveys, but was forced to abandon the project due to lack of funds. The Bureau's experience in this field made it the logical publishing agency, and when the C.F.R. Committee recognized the necessity for a continuing motor-gasoline survey the Bureau was consulted. An agreement was entered into whereby the cooperating laboratories of the C.F.R. Committee would furnish the necessary data to the Bureau, which would undertake the work of analysis, tabulation, and publication. Since that time the report has been issued semi-annually, successive reports covering winter and summer gasolines respectively. The properties reported are octane number, distillation data, vapor pressure (Reid), gravity (A.P.I. and specific), sulfur content, and copper-strip corrosion.

The motor-gasoline survey was initiated at the request of the automotive industry, the motor survey at the request of the petroleum industry. In connection with the latter survey it was necessary to develop entirely new testing techniques; and the uncontrollable variables in the testing were greater in both number and magnitude. Because of this the motor-survey covers the gasoline requirements of passenger cars in only two respects—octane number requirement and limiting vapor-pressure.

Motor Fuel Requirements of 1939 Cars

SINCE 1936 an annual survey has been conducted by the Cooperative Fuel Research Committee to determine the fuel requirements of current-model automobiles with respect to vapor lock and anti-knock characteristics. In 1938 this survey was restricted to Chevrolet, Ford and Plymouth cars, but in 1939 it was extended to all makes of car. Data obtained by 14 cooperating laboratories on 23 1939 models and additional data on some earlier models were reported to the National Bureau of Standards for analysis, and a report on the findings was presented at the meeting by Donald B. Brooks, senior automotive engineer of the Bureau. Since the 1938 tests were made only on Chevrolet, Ford and Plymouth cars, comparisons between 1938 and 1939 are possible only for these three makes, and it was found that whereas in 1938 two-thirds of the cars tested operated with only a trace of knock on gasoline of 70 octane and over, only one-half of the cars of these makes tested in 1939 did so. Of all of the 1939 cars tested, the following percentages gave not more than a trace of knock with fuel of the respective minimum octane numbers:

Percentage of units	10	30	50	70	90
Oct. No.*	61	69	72.5	76	81.5

* Corrected to 29.92 in. of mercury column.

Some cars were tested as received and again after the distributer had been adjusted so that the spark-advance curve conformed to the recommendations of the manufacturer. Proper adjustment materially reduced the octane requirements of two thirds of the cars. A number of cars were tested as received and again after the carbon had been scraped off the cylinder walls, and it was found that the latter operation reduced the octane requirements quite consistently by about seven numbers.

Data on limiting vapor pressures were obtained by six cooperating laboratories on nineteen 1939 models and were also analyzed by the National Bureau of Standards. The results were as follows:

Per cent of total no. of units giving vapor lock.	10	30	50	70	90
Limiting Reid vapor pressure in lb. per sq. in...	7.15	8.35	8.75	9.15	10

In 1939 only relatively few tests were made on the same car at different atmospheric pressures, and the committee therefore retains its equation for the effect of atmospheric pressure on the limiting vapor pressure.

Load Capacities of Journal Bearings

THE USE of data on journal-bearing friction and temperature in establishing criteria for the safe operation of bearings was discussed by S. A. McKee, mechanical engineer of the National Bureau of Standards. The characteristics of the lubricant used are supposed to be known. The method may be used to estimate the effect of changes in a number of the factors involved in the operating characteristics of the bearing. It also provides a means for correlating data on bearing installations where conditions are such that factors affecting bearing operation cannot be readily determined. The two fundamental concepts on which the method is based are the establishment of a minimum safe limit for the generalized operating variable ZN/P, and a maximum safe limit for the operating temperature. With the data available at the present time, the author said, it will provide only an approximate measure of bearing capacity. What is necessary to make possible a more rigorous application is a comprehensive study of the frictional characteristics of journal bearings at the lower values of ZN/P and a complete investigation of the heat-dissipation characteristics of various bearing installations.

Data collected at the National Bureau of Standards on 2-in. diameter copper-lead bearings, with steel backing, in a four-bearing friction machine, supplied with oil under 80-85 lb. per sq. in. pressure through the center of the shaft, the lubricant used being a mineral aviation oil of 124.4 S.U.V. at 210 deg. Fahr. and a viscosity index of 98, when substituted in general equations led to the following equation for the allowable unit pressure on the projected surface of the bearing:

$$P = \frac{1605\ \Delta T^{1.65}}{N} - 0.0103\ Z\ N \text{ lb. per sq. in.}$$

where ΔT is the permissible temperature rise above atmosphere; N, the journal speed in r.p.m., and Z the absolute viscosity of the lubricant at atmospheric pressure and bearing temperature, in centi-poises.

Direction Signals

STANDARDIZATION of certain features of direction signals was suggested in a paper by Harry C. Doane, Buick electrical engineer. A study of the problem by Buick, the author said, had led to the conclusion that arrows should be used to indicate the intention to turn, and that the arrows should be made to flash. A design was worked out in which the bulbs are placed on the under side of the trunk lid, which latter has suitable openings for the light to pass through. This eliminates bulky excrescences and exposed moving parts, and it is reasonably economical to manufacture. In connection with the flashing signals, pilot lights are provided which indicate to the driver whether or not the front or rear signals are operating. On the 1940 Buick there is a flasher which operates on the combined magnetic and hot-wire principle and flashes both front and rear signals simultaneously. Separate contacts controlled by the magnet are used to operate the double pilot bulbs, which latter, when not flashing, indicate that either the front or rear bulb is burned out. The double pilot lights placed behind arrows on the instrument cluster indicate to the driver the direction in which the signals are operating.

One of the most controversial phases of the direction-signal problem is the manner in which the direction switches should be turned on and off. After a full consideration of the various possibilities it was concluded that a system which could be turned on manually by the driver and would be turned off automatically by the motion of the steering wheel as the turn is completed would be the best compromise, and a system of this kind was worked out for the Buick.

The Headlamp Problem

P. J. KENT, chief electrical engineer of Chrysler Corporation, in a paper on The Headlamp Problem, gave an interesting historical review of the development of the automobile headlamp, and particularly of that of the new Sealed Beam headlamp which is carried on practically all 1940 passenger cars; and he concluded by appraising the possibilities of polarized light for automobile illumination. Mr. Kent said the introduction of Sealed-Beam headlamps had resulted in almost universal acceptance of aiming to the center of the hot spot of the upper beam, which makes the aim much less sensitive to surrounding illumination, and, furthermore, attendants in service stations could judge the center of the beam much more accurately than they could the so-called edge of the hot spot to which they formerly aimed. Through cooperation with motor vehicle administrators it was possible to incorporate increased light output in the Sealed-Beam headlamp and the average 1940 car has about 50 per cent more light in the country beam than the average 1939 car.

Together with the adoption of the Sealed-Beam headlamp system have come the following improvements in automobile electric systems:

(1) Almost universal adoption of the shunt-type, voltage-regulated generator with sufficient capacity to carry the full lighting and accessory load without drawing current from the battery.

(2) Improvement in car wiring through simplification and the provision of larger cables in the headlamp and battery charging circuits.

(3) Improvement in headlamp and beam control switches through the use of silver contacts which insure low resistance contacts throughout the life of the car.

For the future the principle of polarized light offers interesting possibilities. What prevents its immediate adoption is that a large proportion of the light emitted by the source is absorbed by the polarizing medium and that the system is really effective only if all cars on the road are equipped with it. Mr. Land, the originator of this system, recently disclosed a new development in polarizing material, polyvinyl alcohol, a transparent plastic specially treated, which can be formed and bonded to a Sealed-Beam headlamp lens. The polarizing material is in a plastic form instead of a crystalline form, and is said to be more durable, and the polarizing property more permanent.

In Mr. Kent's opinion, the most practical way to introduce polarized lighting would be by engineering, management and enforcement procedure similar to that used to introduce Sealed-Beam lighting on 1940 cars. If this procedure were followed and all manufacturers introduced polarized lighting on their new models at approximately the same time, there would still be a difficult problem presented by the old cars, by pedestrians and by drivers of vehicles not equipped with polarizing viewing screens. One safe way to effect the transition would be to require the polarized type of headlight to have two beams and require drivers to continue to depress the beam when meeting other cars for a period of years until the old cars are eliminated. Thereafter fixed-beam lights could be used and the full benefits of polarized lighting secured.

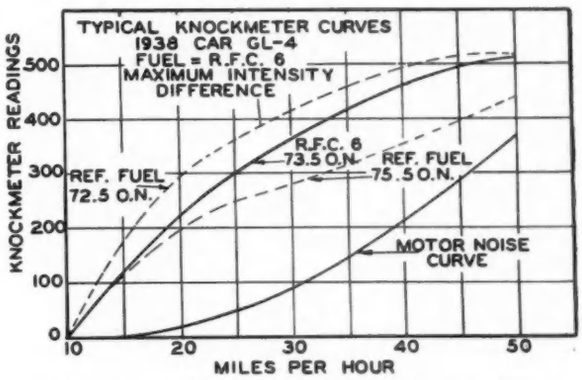
Fuel Distribution in Multi-Cylinder Engines

NEW DATA on fuel distribution on multi-cylinder engines were presented in a paper by Harold J. Gibson and Cleveland Walcutt of Ethyl Gasoline Corporation, whose tests were made on an eight-cylinder in-line engine. Distribution probably is affected most by the relative rate of heat supply to the mixture. Shields and jackets were made for the manifold system which, in conjunction with the hot-spot valve, made possible four distinct degrees of mixture heating. When accelerating through the speed range 13-18 m.p.h. under full throttle the mixture entering any particular cylinder was always leaner when little heat was supplied. The air fuel ratios of the individual-cylinder mixtures varied considerably under any one condition of mixture heating. It was found that mixture heating had little effect on mixture ratios at constant speed, but during acceleration it caused a progressive richening of the mixture up to a temperature of 185 deg. Fahr., beyond which it had little further effect.

Another problem investigated was that of the effect of unequal distribution on the effective anti-knock

values of different fuels. During acceleration, in the lower speed range the heavier ends tend to separate out and to accumulate in the manifold, while in the higher speed range they are drawn into the cylinders, so that at first the mixtures are lean and later rich in heavy ends. It was shown that one of the test fuels used in the work had much better anti-knock qualities in the heavier than in the light end, while the opposite held true in the case of another.

Tests were made also with an intake manifold of one-third the normal section. This caused a marked increase in knock with all of the fuels, but so far no plausible explanation has been found for this effect.



Set of typical curves of knockmeter readings.

Knock Characteristics of Pure Hydrocarbons

KNOCKING characteristics of pure hydrocarbons were determined in General Motors Research Laboratories, and according to John M. Campbell, who presented a paper on the subject, it was found that engine speed and engine temperature had widely different effects on different compounds. The hydrocarbons experimented with were normal heptane, iso-octane, di-isobutylene and triptane (or 2,2,3 trimethyl-butane). Anti-knock tests were made under four basic engine conditions, as follows:

1. 600 r.p.m., 350 deg. Fahr. jacket, 150 deg. Fahr. air
2. 600 r.p.m., 212 deg. Fahr. jacket, 100 deg. Fahr. air
3. 2000 r.p.m., 212 deg. Fahr. jacket, 100 deg. Fahr. air
4. 2000 r.p.m., 350 deg. Fahr. jacket, 150 deg. Fahr. air

The four conditions may be described as low speed—high temperature, low speed—low temperature, high speed—low temperature, and high speed—high temperature. With the triptane the critical compression ratio reached a maximum value (at low engine speed and low engine temperature) of 14.8, whereas with iso-octane it reached a maximum value of 9 (at high engine speed, low engine temperature). In passing from condition 2 to condition 3, the critical compression ratio (anti-knock value) of various gasolines and of normal heptane and iso-octane increased, whereas that of di-isobutylene and of triptane decreased. The author concluded that these results show why it is difficult, if not impossible, by present methods of attack, to assign a definite anti-knock rating to a given fuel which will be valid in different engines under different conditions of operation. As the present trend toward manufactured fuels of high octane ratings advances, the difficulty will become even more acute, because, as shown by the results of the investigation, it is especially these products whose anti-knock value varies through a wide range with engine conditions.

Road-Test Knockmeter

A ROAD-TEST knockmeter was described in a paper by A. E. Traver and C. E. Haberman of Socony-Vacuum Oil Co., Inc., General Laboratories. It consists of a microphone, amplifiers, a detector and an electric indicator. All parts except the microphone are built into a portable metal case and the instrument, including the battery required for its operation, weighs about 25 lb. The cost of the apparatus was stated to be in the neighborhood of $100. The indicating meter is connected in a modified bridge circuit in such a way that there is current flow through the meter only when the electrical balance of the bridge circuit is upset. The detector tube acts as a variable resistance connected in one leg of the bridge circuit, thus controlling the reading of the instrument.

The knockmeter is usually placed on the seat between the driver and the observer, and the microphone is installed outside the engine hood on the side or in front of the radiator. The car is warmed up in the normal manner and ratings are made with full-throttle accelerations from 10 to 50 m.p.h., the observer recording the meter readings at intervals of 10 m.p.h. Before starting a series of fuel tests, the engine noise curve is established by running the car through its normal testing cycle with gasoline of 100 octane number. Actual ratings are made by substracting the engine noise figures from the total meter reading.

A set of typical curves of knockmeter reading vs. car speed are shown above.

Effect of Mixture Ratio on Road Octane Ratings of Fuels

HAROLD M. TRIMBLE, K. C. Bottenberg and L. A. McReynolds discussed results obtained in a series of tests to determine the effect of mixture ratio on the octane-number ratings of a number of fuels chosen by the Cooperative Fuels Research Committee for its 1939 road tests. It was found that for the four fuels investigated, the mixture ratio for maximum knock is in the lean range, extending from 13.75:1 to 14.5:1.

Why Road and Laboratory Ratings of Fuels Don't Agree

PETROLEUM engineers still are having difficulty in getting road and laboratory anti-knock ratings to agree. A. E. Becker and G. H. B. Davis of Standard Oil Development Company said that this is due largely to unequal distribution in multi-cylinder car engines. The knocking tendency is dependent on the mixture ratio and is a maximum at about 14:1 mixture ratio, depending somewhat on the mixture temperature. In the case of fuels with high end point, the higher-boiling-point fractions will drop to the manifold walls and will eventually be swept into some of the cylinders in much greater proportion than into the others. Thus some cylinders will receive a much richer and others

a much leaner mixture than the average. One or more are apt to receive th "critical" mixture, the one required for maximum knock. Hence the particular portions of the fuel that enter these critical cylinders are the ones that largely determine the rating the fuel will have on the road.

For instance, if the over-all mixture ratio is 13:1 and the ratio for maximum knock is 14.5:1, the "critical" cylinders will be those receiving fuel in the ratio of 13:14.5, that is, about 90 per cent of the fuel delivered by the carburetor. Since the heavy ends are the ones that drop out of the mixture in its passage through the manifold, it follows that the 90 per cent of the fuel reaching the "critical" cylinders must be deficient in these heavy ends. Therefore, if more than 90 per cent of the fuel is evaporated, it will be the octane number of this larger percentage of the fuel that determines the road rating of the fuel. On the other hand, if less than 90 per cent is evaporated, the leanest cylinders will not be receiving a mixture of the ratio required for maximum knock, and will therefore act as though they were receiving a fuel of higher octane number.

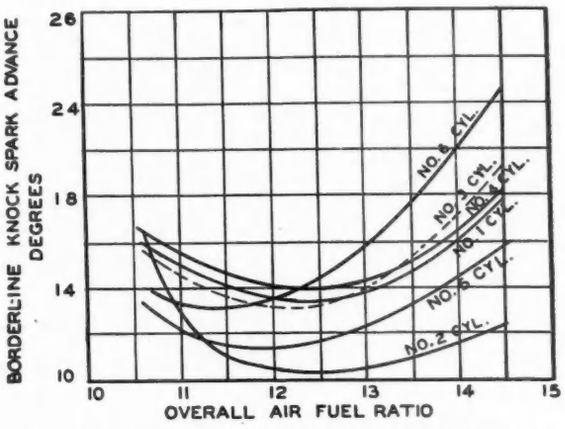
Tests carried out on four cars of different popular makes, under summer conditions, led to the conclusion that the road rating of a fuel is equal to the Research-Method rating of either the first 90 per cent of the fuel to pass over in the still, or the distillate up to 300 deg. Fahr., whichever is the larger portion.

Effect of Car Mileage on Octane Requirements

IT HAS long been known that the accumulation of carbon in combustion chambers and other changes in engine condition affect the octane requirements of cars, but Clarence S. Bruce, assistant automotive engineer of the National Bureau of Standards, presented some quantitative experimental results on this effect. Two cars were used in the tests, each of them being equipped with a neon spark indicator consisting of a neon lamp illuminating a scale attached to the rim of the flywheel of the engine. The neon lamp was energized by the passage of the spark in cylinder No. 1, and a scale graduated in degrees of crank angle was placed on the flywheel, with its zero corresponding to top center for cylinder No. 1. The scale was viewed through a glass-covered hole in the toe-board and a corresponding hole cut in the bell housing. It was necessary to shield the flywheel from extraneous light. Sponge rubber was used between the bell housing and the toe-board, and a black felt tube was used between the observer's eyes and the toe-board hole. The distributor governor case was connected to a screw of sufficient length so that on raising the hood a knurled knob at its upper end was convenient for changing the spark setting without stopping the engine.

The octane requirements rise with the atmospheric temperature; this can be allowed for by a temperature correction, and it was found that a correction of one octane number per 10 degs. Centigrade was right.

The tests further showed that engine operation for 12,500 miles increased the octane number requirement 25 units, seven units being due to carbon accumulation and the remaining 18 units to changes in the condition of the engine. By changing the spark setting of the engine the octane requirement can be kept constant over a large mileage, and in the case of the two cars tested, a change of 9 crankshaft degrees in the spark setting served to keep the octane requiremnts of the cars constant during 12,500 miles of operation.



Graph showing the detonating tendencies of the different cylinders (Drinkard).

Effect of Distribution Characteristics on Knock

A STUDY of the behavior of the C.F.R. road-test gasolines when used in a current-model six-cylinder engine was reported on by W. E. Drinkard of Chrysler Corporation. The principal item investigated was the influence of mixture distribution on detonation characteristics of individual cylinders. The engine was operated at a constant speed of 1200 rpm, wide-open throttle, on a dynamometer. At this speed it developed its maximum M.E.P. and gave about the poorest mixture distribution.

The spark advance resulting in incipient detonation was obtained for each cylinder at four different over-all air/fuel ratios. This was done for each of the four C.F.R. experimental fuels and the two secondary reference fuels (A-5 and C-11). The overall air/fuel ratio was varied from about 11 to 1 to 14 to 1 and was determined by direct readings of air and fuel consumption. The detonating tendency of the individual cylinders was determined by recording the spark advance for incipient knock, one cylinder at a time. An auxiliary ignition unit was driven directly from the crankshaft to make possible this determination. A switch was used which allowed any one cylinder to be fired from either the regular or the auxiliary distributor.

The accompanying graph brings out clearly the difference in the detonating tendencies of the different cylinders and the influence of the over-all mixture ratio, using a given fuel. Detonating characteristics of all six cylinders are superimposed on one another, for two of the C.F.R. fuels. From a general analysis of the distribution in this engine it is seen that cylinders Nos. 2 and 5 tend to run rather rich, and cylinders Nos. 1 and 6 rather lean. Consequently, when operating on fuel No. 5, cylinders Nos. 2 and 5 should receive a mixture of lower anti-knock value than cylinders 1 and 6.

Effect of Carbon Deposits on Octane Number Requirements

JOHN DUCKWORTH of Standard Oil Company of Indiana reported on tests to determine the octane number requirements of three different cars before and after removing carbon deposits accumulated during specified mileages. In car No. 1, which required 77.2 octane number fuel after 39,921 miles, the fuel requirement was lowered to 44.3 octane after carbon removal. In car No. 2 it was lowered from 60 octane number (after 19,345 miles) to 55 octane number, while in car No. 3, in which very little carbon had accumulated during 28,426 miles, there was no reduction from the 71.4 octane number requirement as a result of removing the small deposit.

Effect of Car Mileage on Road Anti-Knock Value

IT is well known that as a car is driven or used, its requirements with respect to fuel anti-knock quality increase considerably. This effect is generally most noticeable during the first 10,000 miles of operation or for a corresponding period after a "valve and carbon job." Simultaneously with the increase in fuel anti-knock requirement the cars also change their relative ratings of fuels with respect to composition or fuel type. T. H. Risk of Pure Oil Company gave some experimental results on the border-line no-knock spark advance relative to car speed with various fuels and for the car when new and after various mileages.

Supercharging Four-Stroke Diesel Engines

A HISTORY of the development of high-speed Diesel engines in this country was given in a paper by Robert P. Ramsey, chief engineer of the Philadelphia plant of the National Supply Company. This development started in the early twenties when a four-cylinder 100-hp. engine weighing 15,000 lb. and turning over at 325 r.p.m. was considered a high-speed engine. In the latter part of his paper the author described a high-speed supercharged marine engine which he has developed for the National Supply Company. This is a four-cylinder 4½ by 5¾-in. engine (366 cu. in.) rated 160 hp. at 2400 r.p.m. Supercharging is by a Roots-type blower driven by belt from the crankshaft, with automatic belt adjustment. The crankshaft has five main bearings of 3½-in. diameter; crankpins are of 2⅞-in. diameter, and all journals and pins are Tocco-hardened. Bearings are of steel-backed copper-lead and steel-backed cadmium-nickel type, and all are pressure-oiled. Cylinder block and crankcase are castings of aluminum alloy. Cylinder heads also are cast of aluminum alloy and contain the Superior dual combustion chamber. For cold starting the compression space can be reduced to give extra-high compression. Pistons are of aluminum alloy and carry one fire ring, two compression and two oil-control rings. Connecting rods are of alloy steel and light in weight. Hydraulic zero-lash tappets are used.

The blower has a displacement of 0.128 cu. ft. per revolution and is driven at 1.42 times crankshaft speed. At idling the inlet pressure is 2 lb. per sq. in. gage; at 2400 r.p.m., 8 lb. With the engine fully equipped, the b.m.e.p. is 165 lb. per sq. in. at the speed corresponding to the peak of the torque curve; at 2400 r.p.m. it is 145 lb. per sq. in. The engine compression ratio with aluminum cylinder heads is 11.8. A stripped automotive engine of this design weighs 1120 lb. or about 7 lb. per hp.

An air cooler is incorporated between the blower and the inlet manifold. This was developed in collaboration with the Young Radiator Co.

Mr. Ramsey expressed the view that the automotive-type Diesel engine of the future may be an engine of smaller displacement than its gasoline-burning competitor, and of about equal specific weight but higher fuel economy.

Fuel Viscosity and Injection Equipment

THE EFFECTS of the viscosity of the fuel on various elements of the injection system were discussed by G. W. Baierlein of the American Bosch Corporation. A high viscosity, of course, has an effect on the delivery of the fuel transfer pumps, and it also affects the operation of the fuel filters, the injection pump and the nozzles.

It was shown by the author that with gear-type transfer pumps the delivery per revolution or the volumetric efficiency increases slightly as the viscosity of the fuel (at 100 deg. Fahr.) increases from 35 to 270 seconds Saybolt Universal, whereas with plunger type pumps the volumetric efficiency increases with the viscosity from 35 to 70 or 75 seconds Saybolt and decreases with a further increase in the viscosity. It was pointed out by the author in this connection that the velocity in the fuel supply tubing should not exceed 3 ft. per sec. With the plunger-type of transfer pump the volumetric efficiency drops off materially at very low viscosities, due to seepage past the suction and discharge valves and leakage past the plunger. The author remarked that as regards the effect of viscosity on the fuel transfer, if the tubing between the tank and transfer pump and the transfer pump is properly chosen there should be no difficulty in getting the fuel to the injection pump even if it has as high a viscosity as 350 seconds Saybolt Universal.

High viscosity, of course, reduces the rate of flow of fuel through the filters. These filters are generally of three types, metal being used as primary-stage filters, cloth as secondary-stage filters, and paper as final-stage filters. The effect of viscosity on the filters may be reduced by increasing the supply pressure, enlarging the filtering surface, preheating the fuel, or employing an additional filtering system such as a centrifuge for filtering heavy fuels. Increasing the supply pressure is objectionable because it reduces the filtering efficiency, and it is better to enlarge the filtering surface or to preheat the fuel, though there is a limit to the practical preheating temperature.

The fuel viscosity has very little effect on the delivery characteristics of injection pumps. As regards the nozzles, if the fuel is of high viscosity and the clearance between nozzle valve and nozzle body is very small, not enough fuel may leak by the valve to ensure proper lubrication.

Investigation of Smoke Control

AN INVESTIGATION on the control of smoke in the exhaust from automotive-type Diesel engines was reported upon by W. W. Manville, G. H. Cloud, A. J. Blackwood, and W. J. Sweeney of Standard Oil Development Company. Smoke density was measured by means of a smokemeter of the type devised by Dr. H. P. Schweitzer and described by him in AUTOMOTIVE INDUSTRIES of Aug. 20, 1938, and a smoke rating of 35 per cent was arbitrarily set as the maximum permissible.

The authors pointed out that in London no smoking buses are allowed in the streets, and the Diesel buses there do not smoke. This is not due to the use of a superior grade of fuel in their engines, for they operate on fuels of 55-60 cetane number with a 50-per cent point of 550 deg. Fahr.—fuels which if used in some Diesel buses in this country would give rise to excessive smoke. The explanation is that the London buses carry oversize engines, so that it is never necessary to force the engines by supplying them with excessive charges of fuel.

The authors made a distinction between operation during periods of acceleration and operation under equilibrium conditions. A high-speed multi-cylinder laboratory engine under equilibrium conditions did not smoke when operating on fuels of 54 and 48 cetane numbers (and 35 and 32 viscosity respectively) but when operating on a fuel of 40 cetane number and 33 viscosity it gave off objectionable smoke at speeds above 1900 r.p.m. This was believed to be due to the long ignition lag with this low-cetane fuel, which resulted in inefficient or incomplete combustion at high speeds. As regards the effect of fuel volatility, it was found that the 50-per cent point of the distillation curve gives the best correlation between volatility and smoke, and not the 90-per cent point, as is often believed. Fuels of a high 50-per cent point are more likely to give a smoky exhaust. For fuels of the same cetane number, those of higher viscosity will produce the most smoke.

Change to a much lighter fuel often overcomes trouble from smoke—but at the expense of considerable loss in power. The authors, for instance, found that change from an automotive Diesel fuel of 500-deg. Fahr. 50-per cent point to kerosene of 430 deg. 50-per cent point resulted in a power loss of 5 to 10 per cent and even more, depending on the state of wear of the injection pump and the nozzles, the pump characteristics, etc. Upon investigation they found that the loss in power was due to a reduction in the fuel charge injected caused by greater leakage of the less viscous fuel. The major part (from 45 to 70 per cent) of the smoke reduction generally attributable to a change in fuel is actually due to the resultant change in power output. Conversely, if the smoke stop on an engine is reset to recover the power lost by changing to a lighter fuel, approximately 45 to 70 per cent of the original smoke will reappear.

PRODUCTION LINES . . . .

Mechanics Problems

Due to a marked increase of interest in applied mechanics, The Macmillian Co., has published a new text entitled, "Problems in Mechanics" by G. B. Karelitz, J. Ormondroyd, J. M. Garrelts, the authors' names being well known in automotive literature. While based upon the classic work of I. V. Mestchersky, this text represents an entirely new arrangement with a large number of new problems. The text is arranged in two parts—the first, consisting of theorems in statics, kinematics, and kinetics; the second, consisting of problems under the same headings. Certain typical problems are introduced with a suggested solution.

Engine Bearings

Much of the progress in automotive products has come from major standardization projects leading to simplification. *Motor Age,* our affiliated Chilton Publications, draws our attention to the need for standardization of engine bearing undersizes for service. And to our mind the situation merits cooperative study in the interests of fleet operators, service establishments, and bearing suppliers. Crux of the problem is the need for an educational program designed to promote the desirability of grinding crankpins and journals to a minimum number of specific undersizes. A corollary to this effort would be the adoption of the kind of grinding equipment and instrumentation essential to the maintenance of such standards. Bearing manufacturers then could confine their efforts to the production and distribution of a minimum number of standard interchangeable bearings. Net result would be quicker service at less cost, with smaller but more adequate field stocks.

Fifty-Five Years

"Life at the Mill"—the 55th Anniversary Issue of the employees' magazine of Cincinnati Milling Machine Co., holds within its covers the absorbing story of an enterprise which started modestly in 1884, prospered and flowered mightily during the intervening years. Growth of the milling machine and grinding business has paralleled the growth of the Queen City itself. On the record we see the energy and vision of its founder—Frederick A. Geier—guiding the destinies of the enterprise from its earliest beginnings. "Life at the Mill" we recommend to factory executives for its history of an important machine tool pioneer, for its studies of the plant, for its notes on the apprentice school and other employee relations activities.—J. G.

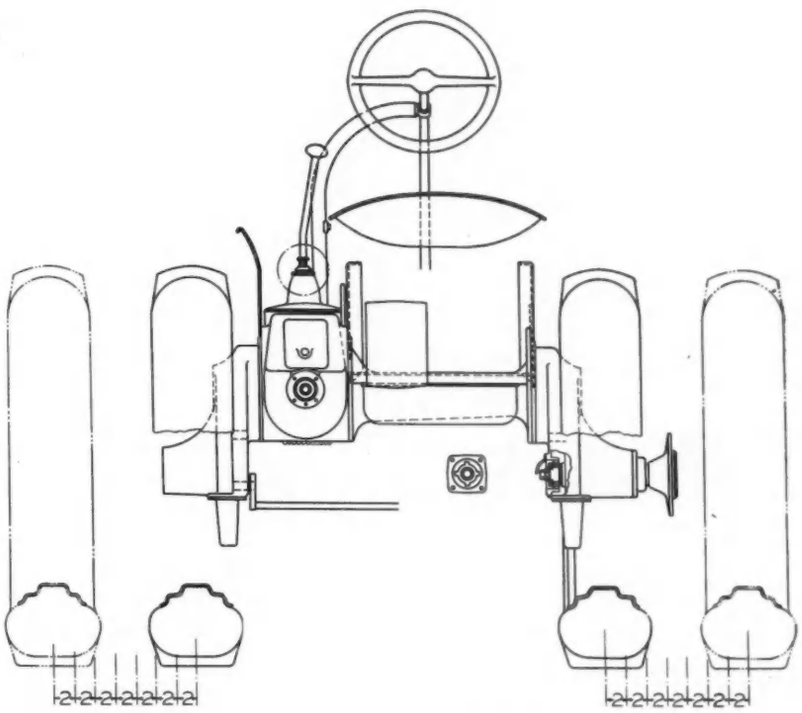
FARMALL MODEL A TRACTOR WITH ADJUSTABLE WHEEL TRACK

Longitudinal Section and Rear View

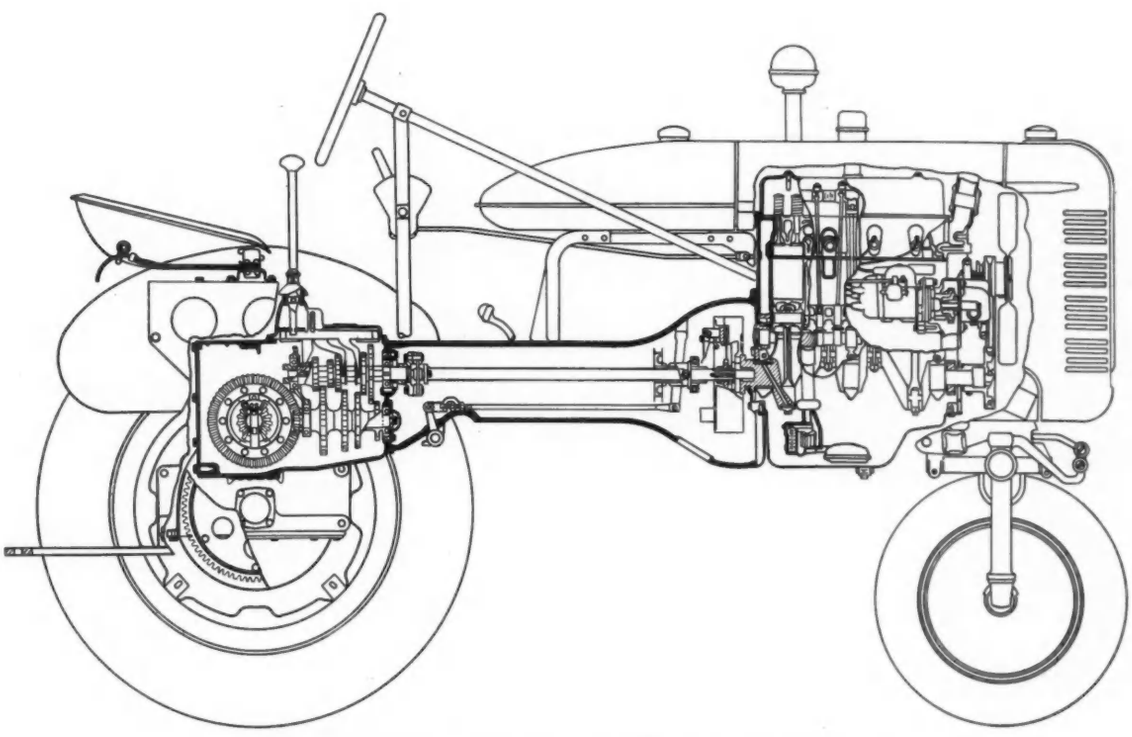
The accompanying illustrations are of the Farmall Model A tractor manufactured by the International Harvester Company. It is equipped with a four-cylinder engine of 3-in. bore and 4-in. stroke which is governed to a maximum speed of 1400 r.p.m. The engine is regularly equipped to burn gasoline, but it can be equipped to burn distillate or kerosene.

The transmission gives four speeds forward and one reverse. When the tractor is equipped with pneumatic tires the forward speeds are 2.2, 3.5, 4.6 and 9.6 m.p.h. The reverse speed is 2.76 m.p.h.

The Model A is of the four-wheel type. Its rear tread can be adjusted in steps of 2 in. between the limits of 40 and 68 in. The front axle normally



Rear view of tractor, showing range of adjustment of rear tread



Longitudinal section of tractor through axis of powerplant

FARMALL MODEL A TRACTOR WITH ADJUSTABLE WHEEL TRACK

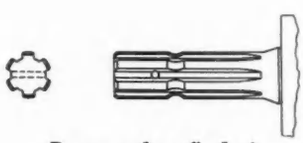
Plan View and Power Take-off Shaft

has a fixed tread of 43 in., but an adjustable front axle is available which makes it possible to make the front wheels track with the rear ones.

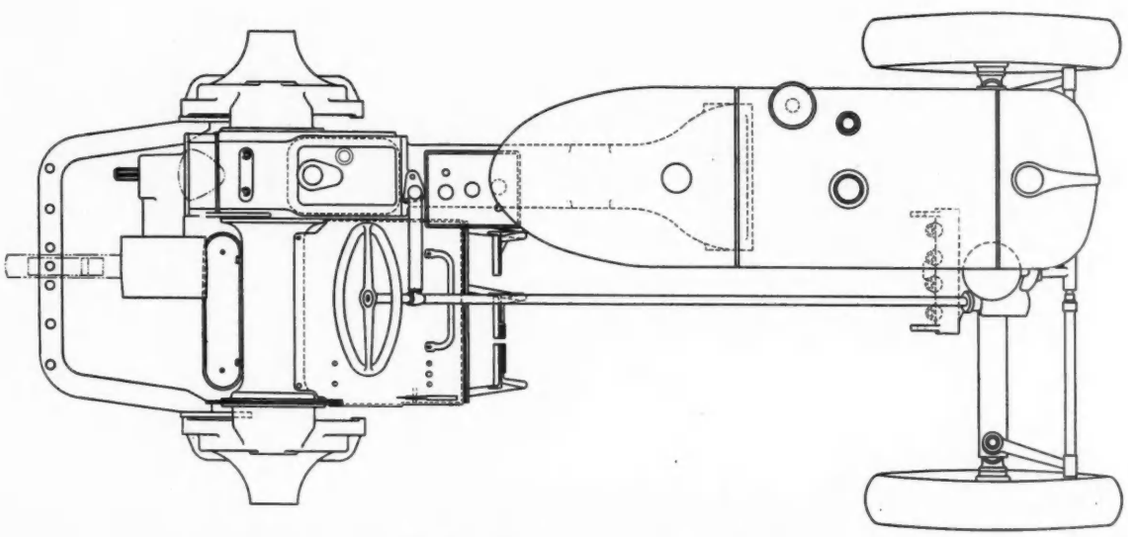
A feature of the Farmall A on which considerable emphasis is laid by the manufacturers is the 9-in. offset of the engine, transmission and seat from the longitudinal axis of the tractor, which materially increases the field of vision of the driver. This increased vision is particularly useful in row-crop cultivation. For other operations, such as disking, the tread is so adjusted that the center line of the draft corresponds with the center of weight distribution of the tractor.

Front wheels carry 4.00 x 15-in. tires which are inflated to 28 lb. per sq. in. Wheel weights of 50 lb. for each of the front wheels are available as special equipment. A number of options are offered on rear-wheel tire equipment, viz., 7.00 x 24, 8.00 x 24 and 9.00 x 24-in. To increase the traction, the tires may be partly filled with water, and cast-iron weights may be attached to the wheels. Two cast-iron wheel weights of 150 lb. each can be attached to each wheel, and are available as special equipment.

As may be seen from the assembly drawing of the tractor, there is no direct drive in the transmission. For each of the forward speeds the power is transmitted from the upper, primary shaft to the lower, secondary shaft, then by bevel gears to the differential shafts, and finally by two sets of spur gears at the end of the axle to the driving wheels.



Power take-off shaft



Plan view of tractor, showing offset of powerplant from longitudinal axis

NEWS OF THE INDUSTRY

New Legislative Program In Spotlight at NADA Convention

Rep. Wright Patman to Introduce Bill Giving FTC Broad Powers Over Manufacturer-Dealer Relations

Consideration of a bill designed to give the Federal Trade Commission broad powers over manufacturer-dealer relations in the automobile industry featured the twenty-third annual convention of the National Automobile Dealers Association which concluded its sessions in Washington on January 25. The measure will be submitted to automobile dealers throughout the country for a referendum.

The direct outgrowth of the FTC's study of the industry authorized under the Withrow resolution in 1938, the proposed new law would require manufacturers, in order to be eligible to sell motor vehicles in interstate commerce, to first have their dealer contracts approved by the FTC. These contracts, the measure provides, would be of a definite term of not less than five years, duties and responsibilities of manufacturers' agents would have to be adequately set forth, and manufacturers could ship no merchandise to dealers except upon written order.

Contracts could not be cancelled except for cause, and then only upon 180 days notice. The contracts would also provide that if a transportation charge is made by the manufacturer, it shall not exceed the actual cost of transportation.

In addition to these provisions, all mandatory, the measure would require manufacturers to undertake certain further obligations in the event the manufacturer-dealer contract was deemed to be the medium for controlling the dealer, as defined by the bill. Under such circumstances, the manufacturer, following cancellation of a dealer contract, would have to agree to purchase the dealer's stock of new cars, parts, accessories and used cars, assume leases entered into with the consent of the manufacturer, and to purchase all other equipment and property of the dealer.

(*Turn to page* 128, *please*)

H. C. Doss

. . . former Dearborn branch manager for the Ford Motor Co. who has been transferred to the home office to take charge of the sales department. The company has announced that J. R. Davis, formerly general sales manager, has been transferred to Long Beach, Calif., as manager of that branch and as sales supervisor over all Ford branches on the West Coast.

Other changes in branch management include the transfer of I. B. Groves from Long Beach to St. Louis; M. N. Johnson from St. Louis to Twin Cities, Minn.; C. I. Kenney from Twin Cities to Indianapolis. R. I. Allen, formerly branch manager at Indianapolis, goes to the home office sales department.

Mr. Jouett Reports

John H. Jouett, president of the Aeronautical Chamber of Commerce of America, trade association of the aircraft manufacturing industry, made the following statements in his report to members at the annual meeting held in New York on Jan. 25:

"Expansion in the American aircraft industry has had a most favorable influence on the employment situation throughout the manufacturing areas. Shop labor in the airplane and engine plants reached 60,000 in January as compared to 30,000 a year ago. This 100 per cent increase was created by large orders for both military and commercial planes that also have caused a rapid upswing in employment throughout the 50 or more allied industries that contribute to the finished flying machine.

"Under present schedules, production of airplanes and engines alone should exceed $500,000,000 during 1940, more than twice that of last year which preliminary estimates place at $225,000,000."

IHC Truck Gets "The Works"

International Harvester Co. completed a new truck proving ground last November near its Fort Wayne (Ind.) plant. This scene shows an IHC truck being put through a grueling workout on what is known as the "twist course."

Construction of the concrete "twist course" provides depressions ranging in depth from 12 in. at one side to 19 in. on the other, built at 45 deg. angles across the road. All units under test are operated over this course several hundred laps and tests must be completed without major failure.

Court Approves Auburn Co.'s Amended Reorganization Plan

Firm Now Selling Automobile Bodies and Materials Said to Have $460,000 in Unfilled Orders on File

The amended plan of reorganization of the Auburn Automobile Co. under section 77-B of the Federal Bankruptcy Law was approved Jan. 20, by Judge Thomas W. Slick in the United States District Court in Fort Wayne, Ind. The company is now selling automobile bodies and materials to General Motors, Packard and International Harvester and is negotiating for contracts with Hudson and Graham-Paige. Unfilled orders totaling $460,000 are said to be now on file. Between 450 and 500 men are now employed regularly with an average monthly payroll of $30,000.

Included in the plan of settlement are: all taxes and preferred claims are to be paid in full and cash; all claims of less than $100 incurred prior to the date of filing of the petition for reorganization, Dec. 11, 1937, to be paid in full in cash; all claims incurred since filing of the petition in the regular course of business, to be paid in full in the regular course of business.

All other claims as allowed by the special master, except those in favor of Aviation and Transportation Corp. and Auburn Automobile Co. as reorganized, are: for 20 per cent thereof common shares of Aviation Corp. on the basis of $7.50 per share; for 40 per cent thereof the four per cent convertible preferred stock of Auburn Automobile Co. as reorganized at $50 per share or the par value thereof; for 40 per cent thereof of the common no par stock of Auburn Automobile Co. as reorganized at $5 per share.

Other provisions of the approved reorganization plan include that all outstanding common stock will be surrendered and cancelled and holders will be entitled to receive one share of new common stock no par value for each 10 shares so surrendered.

No interest will be allowed except to debenture holders and in respect of their claims only to Dec. 11, 1937, in the sum of $47,851.62.

All claims of Auburn Automobile Co. against Aviation and Transportation Corp., its present and past officers, directors and employes, as well as all claims of any kind or nature existing against Auburn Automobile Co. as reorganized, are to be released and forever discharged.

The capitalization of the company will be increased so that upon reorganization the company will be authorized to issue 25,000 shares of $50 par value convertible 4 per cent stock and 500,000 shares of no par value common stock.

Auburn's sales volume in 1939 totaled $1,750,000.

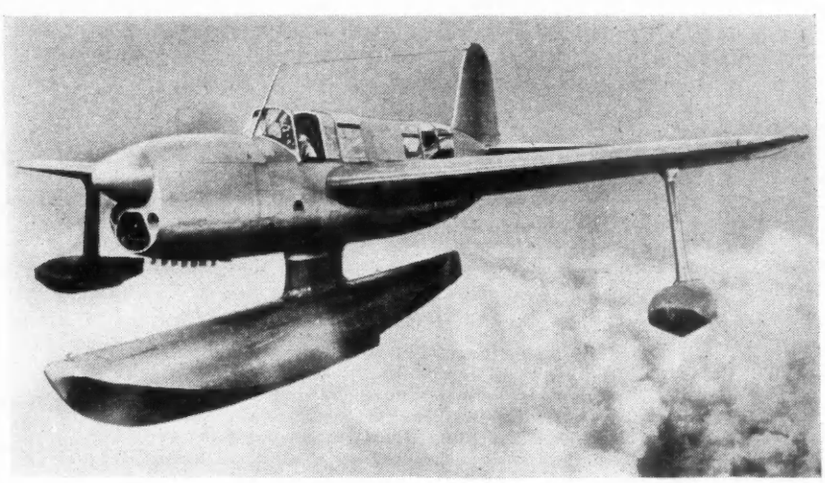
Directors Reelected At Willys Meeting

At the annual meeting of Willys-Overland Motors, Inc., held Jan. 16, all directors, except David R. Wilson, were reelected. Mr. Wilson, former president, resigned and was succeeded by Joseph W. Frazer a year ago. Directors re-elected include Ward M. Canaday, chairman of the board; Joseph W. Frazer; C. O. Miniger; George W. Ritter, secretary; H. J. Leonard; Frank H. Canaday; Burton A. Howe, New York; John Shotwell, treasurer; Milton McCreery; and A. W. Humfeld. Other officers reelected include Delmar G. Roos, vice-president; A. L. Floering, assistant secretary; and Lester S. Lowry, assistant treasurer.

AMA Announces Changes In Committee Structure

Extensive changes in the Automobile Manufacturers Association's committee structure were recently announced by Alvan Macauley, president, following establishment of the Association's headquarters office in Detroit.

Paul G. Hoffman of Studebaker has been named chairman of the Highways Committee, succeeding James D.



IPG

"Convertible" Seaplane

Now undergoing factory flight tests is this fast, new experimental Curtiss X803C-1 scout-observation plane developed for the Navy by Curtiss Wright to operate off battleships and cruisers. It may be equipped as a land plane.

Mooney, who continues a committee member.

B. C. Budd of Packard, has been named chairman of the Export Committee to succeed Robert C. Graham, while H. M. Salisbury of Nash, and R. J. Archer of Willys, have been added to the membership of the committee.

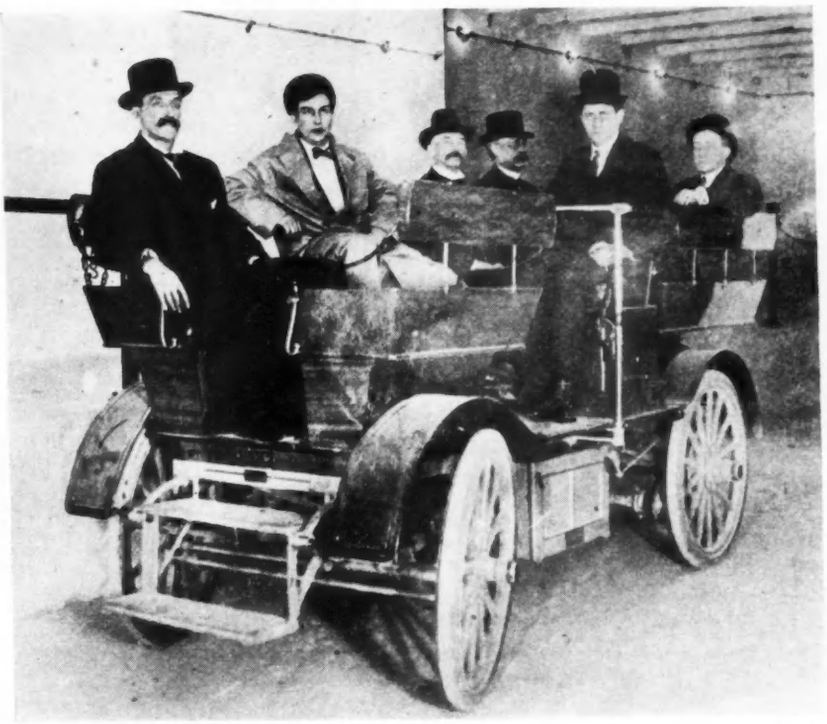
C. E. Wilson, of General Motors, and Herman Weckler, of Chrysler, have succeeded William S. Knudsen, and K. T. Keller, on the Manufacturers Committee. W. F. Armstrong, of Nash, S. W. Seacord, of International Harvester, and F. T. MacRae, of White, have been added to the committee.

Milton Tibbetts, of Packard, and Paul Pippel, of International Harvester, have been added to the membership of the Patents Committee.

Dale Cox, of International Harvester, succeeds Stanley Seward, as a member of the Public Relations Committee.

Fleming Mfg. Co. Becomes Fram Corp.

Name of the Fleming Mfg. Co., East Providence, R. I., manufacturers of the Fram Oil and Motor Cleaner and the Fram Crankcase Hydro-Vent, has been changed to Fram Corp.



Acme

"To the Senate, James!"

This ancient electric vehicle, vintage of 1906, came to light during modernization of Washington's Senate subway monorail car. It was purchased by the Goodrich Co. as a museum piece. The photograph was taken, according to archivists, at the first run of the vehicle.

Financing in November Totaled $113,940,605

The dollar volume of retail automobile financing for November 1939 amounted to $113,940,605, according to the Bureau of the Census, Department of Commerce. This is an increase of 3.8 per cent when compared with October 1939; an increase of 24.4 per cent as compared with November 1938; and an increase of 10.2 per cent as compared with November 1937. The volume of wholesale financing for November 1939, the Bureau reports, amounted to $134,922,225, an increase of 3.5 per cent when compared with October 1939; an increase of 3.2 per cent compared with November 1938; and a decrease of 16.2 per cent as compared with November 1937.

New Car Registrations and Estimated Dollar Volume by Retail Price Classes*

	NOVEMBER, 1939		FIRST ELEVEN MONTHS, 1939			
	Units	Dollar Volume	Units	Per Cent of Total	Dollar Volume	Per Cent of Total
Chevrolet, Ford and Plymouth	117,297	$89,400,000	1,301,665	54.10	$959,700,000	46.73
Others under $1,000	78,304	71,200,000	856,103	35.57	782,200,000	38.09
$1,001 to $1,500	33,097	38,200,000	213,947	8.89	248,000,000	12.08
$1,501 to $2,000	2,084	3,600,000	22,741	.95	35,600,000	1.73
$2,001 to $3,000	740	1,700,000	11,007	.46	25,000,000	1.22
$3,001 and over	31	100,000	676	.03	3,000,000	.15
Total	231,553	$204,200,000	2,406,139	100.00	$2,053,500,000	100.00
Miscellaneous	18	.....	694			
Total	231,571	$204,200,000	2,406,833		$2,053,500,000	

* All calculations are based on delivered price at factory of five-passenger, four-door sedan, in conjunction with actual new car registrations of each model. The total dollar volumes are then consolidated by price classes.

Truck Production by Capacities
(U. S. and Canada)

	ELEVEN MONTHS			Per Cent of Total	
	1939	1938	Per Cent Change	1939	1938
1½ Tons and less	616,997	429,869	+ 44.0	91.67	92.71
2 to 3 Tons	31,851	17,171	+ 85.7	4.73	3.70
3½ Tons and over	12,446	8,629	+ 44.3	1.85	1.86
Special and buses	11,794	8,000	+ 47.5	1.75	1.73
Total	673,088	463,669	+ 45.3	100.00	100.00

Plymouth Adds Two Commercial Models

Two new Plymouth commercial cars, a panel delivery and a "Utility" all-purpose sedan, have been added to the company's 1940 list of special models available for business use.

40 YEARS AGO

The helical gears, the advantages for which for motor vehicles were set forth in *The Horseless Age* of September, 1896, are now coming into use. A well-known manufacturer of special gears recently informed the editor that he had received a number of orders for such gears of double helical, or herring bone, design, and that it seemed probable they would be generally adopted for certain classes of motor vehicle work on account of their noiselessness, durability and economy of power.

From *The Horseless Age*, February, 1900.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE INDUSTRIES**

Business activity was well sustained during the first fortnight of the new year. The New York *Times* seasonally adjusted index for the week ended Jan. 6 stood at 105.9 per cent of the estimated normal, as compared with 106.8 for the final week of 1939. *The Journal of Commerce* unadjusted index rose in the second week of January to 103.6 per cent of the 1927-29 average from 98.0 for the initial period. The Federal Reserve adjusted index of industrial production for December, at 128 per cent of the 1923-25 average, established a new peak; the previous maximum was 125 for June, 1929.

Retail trade during the first two weeks of January ranged from 4 to 13 per cent above corresponding 1939 levels, according to Dun & Bradstreet estimates. Department store sales during the four-week period ended Jan. 6 were 9 per cent greater than a year ago, according to the Federal Reserve compilation.

Production of electricity by the light and power industry increased in each of the first two weeks of the year and in the second period was 14.2 per cent above the corresponding output last year.

The movement of railway freight increased during the fortnight but at less than the usual seasonal rate. Loadings in the second week totaled 667,731 cars, as against 582,244 a year ago.

Bank debits to individual accounts in leading cities during the week ended Jan. 10 dropped 20 per cent below the total for the preceding week and were one per cent above last year's comparable amount.

Average daily production of crude oil during the week ended Jan. 13 was 3,592,200 barrels, as compared with 3,584,450 barrels in the preceding week, and was 22,500 barrels above the required output as computed by the Bureau of Mines.

Production of bituminous coal during the week ended Jan. 6 averaged 1,743,000 tons daily, as compared with 1,646,000 tons for the week before and 1,486,000 tons a year ago.

Cotton-mill activity advanced more than seasonally in the first week of January; The New York *Times* adjusted index stood at 147.3, as against 145.5 for the preceding week and 124.5 a year ago.

Professor Fisher's index of wholesale commodity prices for the week ended Jan. 13 stands at 86.1 per cent of the 1926 average, as compared with 86.3 for the week before and the 1939 final and peak figure of 86.2.

Excess reserves of the member banks of the Federal Reserve system rose $120,000,000 during the week ended Jan. 17 to an estimated total of $5,500,000,000. Business loans of the reporting members a week earlier, $4,363,000,000, were $545,000,000 above the corresponding 1939 total.

Tin Prices Sagging After War Boom

Automotive Consumers Are Said To Have Covered Nearby Requirements At Much Higher Prices Than Now Quoted

Tin, which at the outbreak of the war sold at as high as 75 cents a lb., went begging for buyers at 45 cents during the week ended Jan. 25. Leading automotive consumers, it is said in the market, covered their nearby requirements at considerably higher prices than those now quoted, and are in no mood to take on additional tonnage at this time even at what appears to many to be the bottom of the recession.

There is talk in London of fresh efforts to stabilize the price of tin at around prevailing levels, the buffer pool being expected to resume protective buying in the event of attempts to bring prices down further. The speculative element on the London Metal Exchange is keenly disappointed that removal of maximum prices, a step that was taken to enable British traders to reap profits presumed to have been made by American importers, failed to stimulate dealings in tin. It is pointed out, however, that tin consumption continues high and that it would take very little in the way of a shift in the flow of the metal from Eastern mines and smelters, which so far has been but little interrupted by the war, to change market conditions over night.

In the light of renewed warnings from Washington against the resale of tin to other nations, presumably Russia and indirectly Germany, the recent volume of U. S. imports may have exceeded our domestic needs. Although there has been a paucity of comment on the smelting and refining in the United States of Bolivian tin ores in the British metal press, it is possible that this development may act as a restraining influence on runaway tin market conditions.

Following a number of successive price reductions the copper market, so far as concerns producers' and custom smelters' prices, has now settled on a basis of 12 cents per lb. for spot electrolytic, $10 a ton down from the year's opening. In the "outside" market where until recently premiums were paid to resellers of spot metal, there are now sellers at 11.87½ cents. With zinc prices also lowered a quarter of a cent per pound, prices of automotive brasses have been readjusted in conformity with the lower metal prices.

Further indication of keen competition for flat rolled tonnage business from automobile manufacturers, expected to be placed in the near future, was seen in a $2 per ton concession on sheets offered by some rolling mills in the Detroit area. Steel mills operated this week (Jan. 25) at 82.2 per cent of ingot capacity, compared with 84.8 per cent in the preceding week.—W. C. H.

PUBLICATIONS

"Propaganda for Democracy," an address delivered at the forty-fourth Annual Congress of American Industry by Paul Garrett, director of Public Relations, General Motors Corp., has been printed in booklet form.*

A paper entitled **"Improving Driver Responsibility"** by E. W. James, chief, division of Highway Transport, Public Roads Administration, Federal Works Agency, has been published in pamphlet form. Mr. James presented this paper at the annual

New Truck Registrations

	November 1939	October 1939	November 1938	ELEVEN MONTHS 1939	ELEVEN MONTHS 1938	Per Cent Change, 11 Mos. 1939 over 1938	Per Cent of Total Eleven Months 1939	Per Cent of Total Eleven Months 1938
Chevrolet	14,879	13,091	9,333	155,744	107,354	+ 45.0	34.66	32.15
Ford	12,312	7,694	5,725	117,357	92,450	+ 27.0	26.12	27.69
International	5,160	7,136	4,088	61,115	51,904	+ 18.0	13.60	15.55
Dodge	2,448	3,244	1,088	46,189	31,058	+ 49.0	10.28	9.30
G. M. C.	3,383	3,188	1,211	32,137	18,383	+ 75.0	7.15	5.51
Plymouth	364	515	176	7,985	6,346	+ 26.0	1.78	1.90
Mack	599	774	490	6,162	3,983	+ 55.0	1.37	1.19
Diamond T	522	570	349	4,904	4,106	+ 19.4	1.09	1.23
White	406	455	302	4,271	3,226	+ 32.3	.95	.97
Studebaker	150	162	141	2,024	1,836	+ 10.2	.45	.55
Autocar	157	183	147	1,938	1,511	+ 28.2	.43	.45
Brockway	154	181	124	1,694	1,201	+ 41.2	.38	.36
Federal	217	251	101	1,635	1,272	+ 28.5	.36	.38
Willys-Overland	162	145	103	1,460	1,771	− 17.6	.32	.53
Divco	169	117	106	1,332	1,151	+ 15.8	.30	.34
Reo	8	20	229	845	2,732	− 69.0	.19	.82
Bantam	52	55	.....	553	.....	.....	.12	.....
Hudson	5	10	31	371	691	− 46.3	.08	.21
Sterling	28	26	26	308	235	+ 31.0	.07	.07
Indiana	11	9	34	173	414	− 58.2	.04	.12
F. W. D.	20	9	9	166	257	− 35.3	.04	.08
Miscellaneous	80	88	130	925	1,994	− 53.6	.22	.60
Total	41,286	37,923	23,943	449,288	333,875	+ 34.6	100.00	100.00

meeting of the American Association of Motor Vehicle Administrators.

In its "Tip Sheet No. 4" the Andrew C. Campbell division of American Chain & Cable Co., Inc., Bridgeport, Conn., introduces the new **Campbell No. 250 nibbling machine.**

Johnson Bronze Co., New Castle, Pa., has issued a catalog which covers a new size listing of its **Ledaloyl self-lubricating bearings.***

McCollum Hoist & Mfg. Co., Downers Grove, Ill., has issued two circulars, one entitled **"Universal Chain Hoists,"** the other, **"The Mac Universal Electric Hoist."***

The B. F. Goodrich Co., Akron, has issued a new 24-page catalog section on **fractional-horsepower V-belt design.***

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

ADVERTISING

Carleton S. Spier, Fred B. Manchee, and Leslie S. Pearl have been elected vice-presidents of Batten, Barton, Durstine & Osborn, Inc., New York.

Aluminum Co. of America has increased its advertising schedules for business and trade papers for 1940, according to C. C. Carr, advertising manager.

Allis-Chalmers Mfg. Co., Milwaukee, is launching a campaign publicizing its new Diesel-powered heavy-duty tractor. The Cleveland Diesel division of General Motors will launch a series of advertisements pointing out that the powerplant is a G.M. unit.

Electric Auto-Lite Co., Toledo, has signed Anne Sheridan, the Texas movie glamour girl, to do a stint for their spark plugs, states Frank A. Nealon, general sales manager.

GM Again Leads All In Magazine Advertising

Chrysler Moved to Second Place, and Ford Advanced to Ninth Position in 1939

For the third consecutive year, General Motors led all national advertisers in the volume of magazine space, the *Advertising Age* annual survey for 1939 shows. Chrysler Corp. moved from third place in 1938 to second place in 1939, regaining its 1937 position. Ford Motor Co. moved to ninth place among all major advertisers from seventeenth, the third largest automobile advertiser, followed by Nash division of Nash-Kelvinator, Studebaker Corp., International Harvester, Packard, Hudson, and White Motor Co., in that order. Eliminating non-automotive advertisers, the magazine shows the following:

Company	1939	1938	1937	1936
General Motors Corp.	$6,010,681	$4,121,647	$6,993,325	$7,289,547
Chrysler Corp.	3,138,495	2,614,849	3,396,927	3,356,416
Ford Motor Co.	1,826,753	1,128,516	1,579,682	1,749,701
Nash Division	783,420	228,918	548,735	534,417
Studebaker Corp.	644,719	556,826	788,715	554,396
International Harvester Co.	580,992	614,825	507,133	438,108
Packard	551,944	531,135	716,526	676,513
Hudson	475,533	180,099	613,971	537,011
White Motor Co.	135,425	27,455	70,496	41,328
	$14,147,962	$10,004,270	$15,215,510	$15,177,437

UAW-CIO Campaigns For Support of GM Employes

Serves Advance Notice on Corporation Of Basic Demand for Contract Revisions

The UAW-CIO launched an active campaign for the support of General Motors employes on Jan. 24 when it announced the basic demands for contract revisions that it would serve on the corporation in case it is returned a winner in the elections expected to be held under the auspices of the National Labor Relations Board. In taking this step the union anticipated the actual dates on which the elections will be held inasmuch as hearings by the NLRB to determine the manner and time and even the decision as to whether elections will be held were not scheduled to begin in Detroit until Jan. 30.

It is commonly expected that the hearings will result in the establishment of dates and machinery for holding the employe elections in all GM plants to determine which union shall represent employes in negotiations with the company and by announcing in advance the demands it would make, the UAW-CIO expected to win the active support of its present membership as well as others now affiliated with rival unions or no union at all.

These basic demands include: A guaranteed annual wage with a 30-hour week of five six-hour days at 40-hour pay, vacations with pay for all employes covered by the contract, pay on a day rate rather than hourly rate basis, improved seniority provisions, joint time studies by representatives of the union and management on operations subject to dispute, and various miscellaneous proposals covering overtime, night work, time allowed stewards and committeemen for handling grievances, appeals, etc.

These demands would require basic revisions in the present contract between the original UAW and the corporation, which in a number of plants has been inoperative because of conflicting representation claims of the

(*Turn to page* 132, *please*)

AUTOMOTIVE INDUSTRIES

Summary of Automotive Production Activity

BUSES A gradual, steady increase of activity seems to be general throughout the field. One manufacturer "pretty well loaded for first half of 1940."

TRUCKS Reports from manufacturers indicate January far ahead of normal expectations and outlook for first quarter "exceedingly good." A leading builder "at a loss" to explain excellent volume of business at this time of year. How long is it going to keep up? "It's anybody's guess."

TRACTORS Fairly high rate of production. Some tractor makers feel that present sales and deliveries by dealers may be due to anticipation of a rise in tractor prices. In general, manufacturers expect "excellent year."

AUTOMOBILES Despite slight tapering off of car and truck production in latter half of January, weekly output continues above 100,000 mark. January total estimated at 460,000. Highest previous January was in 1929 when 422,538 cars and trucks came off the lines.

MARINE ENGINES Thirty-fifth annual Motor Boat Show in New York said to be "best in recent history of industry." With a large number of actual sales in hand and good prospects, manufacturers have high hopes for 1940. Widening interest for compression-ignition powerplants for both workboat and pleasure craft installations, reported.

AIRCRAFT ENGINES Increased interest in private aircraft, and continued demand from government and export sources are keeping factories on heavy production schedules. A vast amount of new development work is also said to be underway.

This summary is based on confidential information of current actual production rates from leading producers in each field covered. Staff members in Detroit, Chicago, New York and Philadelphia collect the basis information, in all cases from official factory sources.

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MEN . . . . . .

Harry Strohm is now associated with the sales department of King-Seeley Corp., Ann Arbor, Mich.

Russell H. Dragsdorf has been appointed Dodge truck plant manager, replacing R. M. Hidey, recently deceased. Coincident with Mr. Dragsdorf's appointment it was announced that **A. S. Anderson**, for several years in charge of the special equipment engineering department of the plant, has assumed the additional duties of labor relations supervisor. **Harold Hocker**, who has also been connected with Dodge truck manufacturing for several years, is now plant engineer.

Charles R. Weaver, for the past four years affiliated with the Automobile Manufacturers Association on export matters, has been appointed secretary of the organization's Export Committee and manager of its Export Department. Mr. Weaver succeeds George F. Bauer.

Herbert Acason, has been placed in charge of Buda automotive and industrial engine sales for the Production Equipment Co., Los Angeles, Calif. The company recently announced a considerable expansion of its Buda engine sales activities.

Harold Swanton has been elected vice-president of Precision Bearings, Inc., Los Angeles, Calif., succeeding Norman Bell, resigned.

Dr. A. Lloyd Taylor has been appointed to the technical staff of Oakite Products, Inc., New York City. Dr. Taylor was formerly director of the Department of Chemistry of Pease Laboratories, New York City.

Felix Doran, Jr., has been appointed general manager of the Fleet Sales Division of General Motors Corp. Mr. Doran succeeds C. E. Dawson, who is taking an extended vacation because of ill health.

Three recent promotions and reassignments in the manufacturing staff of the Buick Motor Division of General Motors Sales Corp. are: **Harry Herron**, for the past six years superintendent of the sheet metal plant, named to special assignment in connection with future die design and manufacturing development; **A. R. Middleton**, formerly assistant superintendent, becomes superintendent of the plant; **Arthur W. Maves**, formerly night superintendent, becomes assistant superintendent.

C. H. McCollam, metallurgist of the Steel & Tube Division of the Timken Roller Bearing Co., has been appointed assistant director of steel sales.

Garvin A. Drew has been appointed to the position of general sales manager for A. Schrader's Son Division of Scovill Mfg. Co., Inc., Brooklyn, N. Y.

Raymond C. Cosgrove, long associated with the Westinghouse Electric & Mfg. Co. of Pittsburgh, has been named a vice-president of the Crosley Corp., Cincinnati, and general manager of the manufacturing division of the latter company.

Charles Merz, pioneer race driver, recently took up new duties as assistant to Theodore E. (Pop) Myers, general manager of the Indianapolis Motor Speedway.

Howard R. Hafferkamp has been appointed supervisor of purchases for the Bendix-Westinghouse Automotive Air Brake Co. at Pittsburgh. Mr. Hafferkamp will make his headquarters in the company's manufacturing division at Wilmerding, Pa.

William L. Batt, president of SKF Industries, Inc., has been elected chairman of the board of directors of the American Management Association. Mr. Batt also was recently elected chairman of the Business Advisory Council of the Department of Commerce, succeeding **W. Averell Harriman**, chairman of the board of the Union Pacific railroad. **John D. Biggers**, president of the Libbey-Owens-Ford Glass Co., was elected as a vice-president.

Russell G. Ford has been promoted to the position of general purchasing agent for the central office of the Chev-

• • • *Unequalled* SURFACE SMOOTHNESS and SPHERICITY

The series of lapping operations performed as a matter of course in the Strom plant give Strom Steel Balls a degree of surface smoothness and sphericity that has always been unequalled in any other regular grade of ball. Only through such unique lapping practice can extreme precision be obtained.

Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Strom Balls.

Other types of balls—*stainless steel, monel, brass* and *bronze*—are also available in all standard sizes. Write for catalog and prices.

Strom STEEL BALL CO.
1850 So. 54th Avenue, Cicero, Ill.
The largest independent and exclusive Metal Ball Manufacturer

rolet Motor Division of General Motors Sales Corp. Mr. Ford's assistant will be **Howard Dingler,** formerly material supervisor for the central office. Successor to Mr. Dingler is **James Carney,** who has been serving as assistant material supervisor. Mr. Carney's position will be filled by **William Wilson** who returns to the central office in Detroit from St. Louis where he has been material supervisor for the St. Louis plant.

Clyde M. Vandeburg, former Coloradoan and publicity executive of three recent World's Fairs, has been made public relations director of the Packard Motor Car Co.

Howard A. Flogaus has been named chief engineer of the J. G. Brill Co.

James A. Wright, sales manager of the Indian Motorcycle Co., has been reelected for his fifteenth term as president of the American Motorcycle Association and the Motorcycle and Allied Trades Association. Other officers reelected were: **Frank Weschler,** Worcester, Mass., vice-president; **Arthur Davidson,** Milwaukee, treasurer; **E. C. Smith,** Columbus, Ohio, executive secretary.

N. E. MacEwan has been appointed as sales representative in the Detroit area for the Stolper Steel Products Corp., Milwaukee.

Fred L. Beelby has been named vice-president in charge of wholesale sales for the Studebaker Sales Corp. of Chicago.

H. R. Norgren has been made assistant general sales manager in charge of special accounts for the Detroit Rex Products Co., Detroit. Other recent promotions are: **D. E. Williard,** assistant general sales manager in charge of regions and branch offices; and **R. A. O'Reilly,** manager of dry cleaning division.

Sidney D. Williams has been appointed vice-president and placed in charge of sales for the Copperweld Steel Co.'s new steel division at Warren, Ohio.

C. B. Thomas, general sales manager of Chrysler Corp.'s export division, left Detroit by plane on Jan. 13 to make a first hand study of automotive markets and possibilities in Latin America. Meetings with distributors and Chrysler fieldmen in 11 cities in the West Indies and throughout South America have been arranged. Mr. Thomas will make the entire trip of 15,000 miles by air.

Bertram M. Ainesworth, who has been associated with Designers for Industry, Inc., as merchandising counsel, has been appointed eastern sales manager, with headquarters in New York. **Charles L. Bennett** has been made western sales manager for Designers for Industry, Inc., and will have headquarters in Chicago.

Francis H. Fenn has been elected president and general manager of the American Bantam Car Co., succeeding **Roy S. Evans,** who resigned. Mr. Evans retains his connection with Bantam as chairman of the board of directors.

George W. Plaisted, vice-president of the Austin Co. in charge of west coast operations for the past seven years, has been named vice-president and general sales manager of the company with headquarters in Cleveland.

Caterpillar Offers New Marine Engine

An addition to its line of marine engines has been announced by the Caterpillar Tractor Co., Peoria, Ill. The new 25 hp. engine, designated as model D3400, is intended especially for small, open type work boats. It has four cylinders, with a bore of 3¾ in. and a 5-in. stroke. Maximum horsepower output of the engine is at 1500 r.p.m., and its rating is for continuous, sustained service.

Like all other "Caterpillar" models, the D3400 is offered with an auxiliary gasoline engine as standard starting equipment, but is available also with electric starting. The new marine model is available with Twin Disc reverse and reduction gears with ratios of 1.62, 2.36, or 3.2 to 1, giving propeller speeds of 926, 635 and 469, respectively.

PHONE RYERSON any time . . . for any amount . . . or any kind of steel. Your order will get Immediate Action. The steel is in stock, and will be delivered promptly — where and when you need it.

When steel inventories are low, when you need unusual sizes or analyses, when non-uniform quality steel hinders production, call Ryerson. Over 10,000 sizes, shapes, and kinds of steel and allied products — from structurals to stainless, from heat treated alloys to nuts and bolts — are included in Ryerson Certified Steel products. All are closely controlled as to analysis, accuracy, finish, etc., and each represents the highest quality in that particular class and type of material.

Ten strategically located plants assure prompt, dependable service. Draw on the one nearest you. We'll gladly send a Stock List.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cincinnati, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON CERTIFIED STEELS

RYERSON

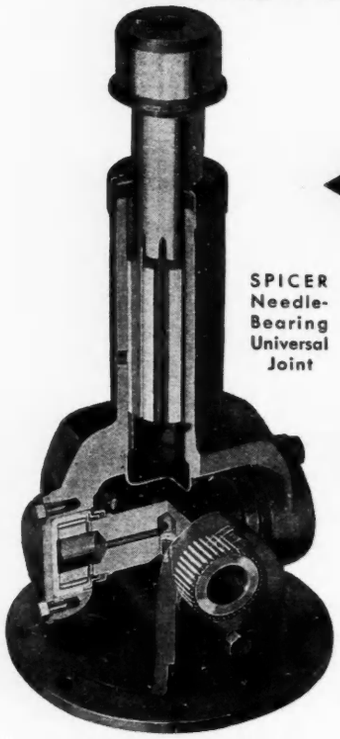
Acme

"Jallopies" on Ice

The automobile racing fiends of East Jaffrey, N. H., get and give plenty of thrills when they average 70 m.p.h. over the glass-like surface of frozen Contoocook Lake. Old automobile chassis are used, such as those shown sliding around a curve on the mile long track. Races are held on Sundays and are usually four, five and 10 laps.

IN DESIGNING UNIVERSAL JOINTS

Spicer Knows How!



SPICER Needle-Bearing Universal Joint

SPICER Needle-Bearing Assembly

Exclusive Licensees under Goetz U. S. Patent RE 18080

● When you specify Spicer Needle-Bearing Universal Joints you get the advantages of Spicer's 37 years of experience in designing and building the features you want most. Spicer Joints give you greater all-around efficiency, less friction, quieter operation, positive lubricant retention, increased load capacity, wider angularity, fewer reciprocating parts, longer life. All these features have been tested and proved through millions of miles of service in passenger car, truck, bus and tractor motors. To get the results in better performance and economical operation, always specify genuine Spicer Universal Joints.

Spicer LABORATORY TESTED SERVICE TESTED

Spicer Manufacturing Corporation • Toledo, Ohio

BROWN-LIPE CLUTCHES and TRANSMISSIONS | SALISBURY FRONT and REAR AXLES | SPICER UNIVERSAL JOINTS | PARISH FRAMES READING, PA.

NADA

(*Continued from page* 121)

Representative Wright Patman, Democrat, of Texas, and co-author of the Robinson-Patman anti-price discrimination law, will introduce the new bill in the House. Mr. Patman addressed the convention on Jan. 24, assuring the 1000 assembled dealers that their present security is "not equal to the plantation share cropper's contract" and that it would not be "unreasonable" to ask the government to give automobile dealers "fair and reasonable security." In return for sponsoring the NADA bill in Congress, the Texan expects members of the NADA organization to support his anti-chain store tax bill which he has unsuccessfully sponsored in Congress for the last two years.

Starting with the opening address by NADA President Stanley H. Horner, Washington Buick dealer, the convention adopted the FTC automobile study as the keynote. J. Schiott, NADA secretary, of Bridgeport, Conn., told the convention that the FTC study confirmed the dealers' contention that they have been "holding the bag." It was his suggestion that the best way out for the industry would be to seek legislation legalizing a method for determining the cash value of used cars trade-ins if, as held by some, the fair trade laws do not permit a definite valuation of used cars.

Donald R. Richberg, former NRA administrator, threw cold water on the proposed program with this warning:

"If you invite political regulations to take the management of your business out of your hands, then I say with no irreverence—God help you!"

C. W. Bishop, the association's general counsel, was more optimistic about stabilizing the new car price and restricting trade-in allowances through the fair trade laws, under which resale price maintenance is legalized in 44 states and permitted in interstate commerce under the Federal Miller-Tydings resale price maintenance statute. Mr. Bishop declared that price stability under present laws could be made to work "if manufacturers were willing to cooperate wholeheartedly."

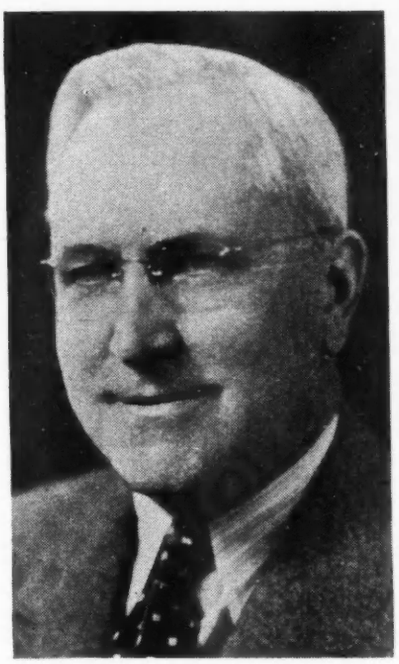
General Motors Corp. already has embodied in its latest selling agreement

a maximum price policy, Mr. Bishop said, adding that because manufacturers had refused and failed to take the necessary second step by putting a ceiling on used car allowances under the fair trade laws, dealers were laboring under a severe hardship. He commended General Motors for revising its selling agreements and cited the new Chevrolet agreement which guarantees dealers a definite term of at least one year.

The Wisconsin automobile dealers licensing law, under which the State Banking Commission supervises manufacturer-dealer relations, was analyzed by Harlan W. Kelley, who told the convention that experience under the Wisconsin law convinces him that "you can have 10 licensing laws and 10 efficient administrative commissions and some dealers will still go broke." He qualified his remarks, however, to the extent of acknowledging that "some federal legislation" will be necessary "to correct abuses," but that supplemental state legislation, which he indicated is on the increase, is essential in dealing with intrastate business.

It was apparent at the convention that at least some dealers had their fingers crossed in advocating the new legislative program. There was considerable opposition to a plan which would involve the dealers in extended federal control over the industry and at least one speaker recognized that its success in Congress is far from assured and he recommended that the NADA lay plans to strengthen its organization in the event the proposed legislation "should not be adopted."

Paul V. McNutt, Federal Security Administrator and Democratic candidate for the Presidential nomination in the event President Roosevelt decides not to run, did not endorse the NADA's proposed law, but he said in a speech to the convention on "Social Security and Business Security" that in the realization of an expansion of consumers' industry "there are certain definite functions which the government can and must perform to make possible the effective exercise of the powers of business."



Aben E. Johnson

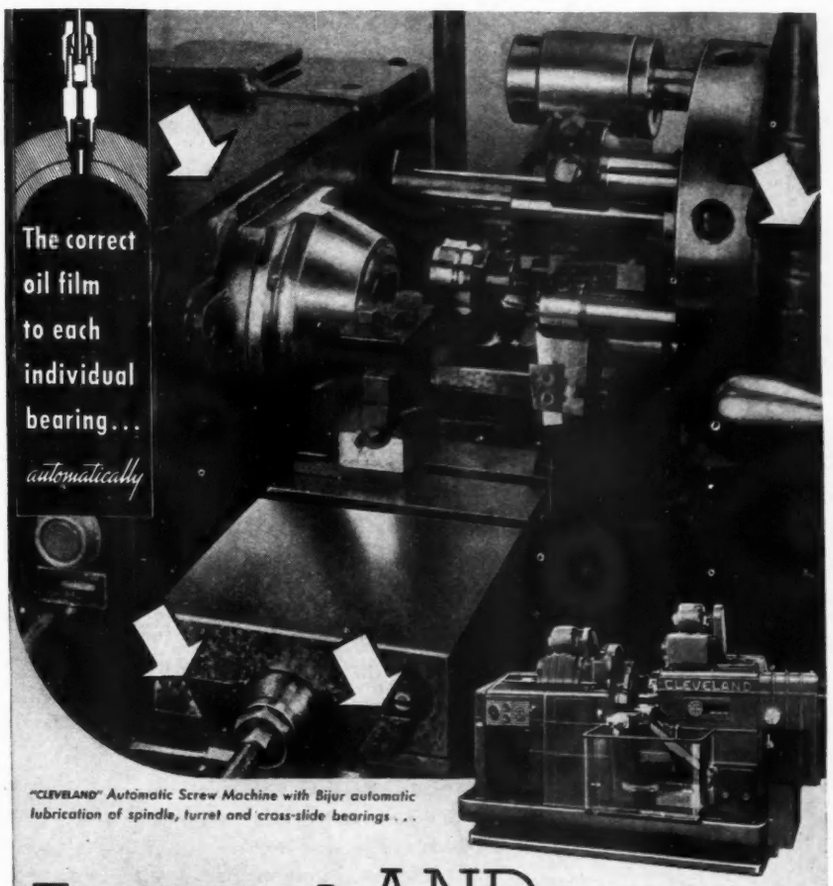
. . . . . elected president and treasurer of the Hastings Mfg. Co., Hastings, Mich., in a recent realignment of officers of the company. Mr. Johnson was for many years vice-president and general manager.

Other officers are: Harold P. Phillips, first vice-president and director; Hal R. Keeling, vice-president and director; C. W. Dolan, secretary and director; Don A. Siegel, assistant treasurer and director.

H. D. Cook and C. W. Crawford are directors of the firm.

George E. Gustafson

George E. Gustafson, 39, works manager of Kearney & Trecker Corp., Milwaukee, Wis., was killed Jan. 8 in an automobile accident. Mr. Gustafson was associated with the corporation for 13 years during which period he served as salesman in Philadelphia, Chicago and Detroit, then sales engineer, advertising manager, and for the past three years works manager.



"CLEVELAND" Automatic Screw Machine with Bijur automatic lubrication of spindle, turret and cross-slide bearings . . .

For speed AND ruggedness

● Whatever the bearing surface, its location or lubrication need, BIJUR maintains the correct, metered oil film—automatically. Any number or combination of bearings—any type of machine! For high production maintained over long periods . . . Bijur *built-in* lubrication.

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AUTOMATICALLY *Correct* LUBRICATION

AMA Urges Renewal Of Reciprocal Trade Act

Brief Submitted to House Ways and Means Committee Points Out Benefits to Farmer, Labor and Industry

Citing importance of the Reciprocal Trade Agreement Act as a contributor to domestic prosperity as well as foreign sales, B. C. Budd, chairman of the Automobile Manufacturers Association's export committee and vice-president of Packard Motors Export Corp., urged renewal of the Act in a statement submitted to the House Ways and Means Committee on behalf of the Association. The A.M.A. brief emphasized that while trade agreements have contributed to an expansion in automobile exports, nonetheless, between 85 and 90 per cent of the motor vehicle production of the country is sold domestically.

"We would not endorse Trade Agreements if it were thought they jeopardized or adversely affected the home market, where such a preponderance of our production is sold," Mr. Budd pointed out.

There were more new motor vehicles bought in the single state of Louisiana in 1937 than were exported to the Union of South Africa, this country's largest single foreign market, Mr. Budd's statement continued. Two mid-western farm states, Illinois and Iowa, took more completed vehicles in the same year than all foreign markets combined.

"Recently," Mr. Budd stated, "fear has been expressed by some opposed to this Act that increased imports will be harmful to the welfare of the American farmer. We do not share this belief. As a group, the farmers of this country are our best customers and we are certainly mindful of those who buy such a large share of our products."

Referring to the results of increased automobile exports, Mr. Budd stressed the employment, and consumption of farm and factory products, resulting from production of vehicles for export.

If Service is important to you.. ..Here it is!
THERE are two advantages of service we have to offer you — you'll find them to be as dependable as Accurate quality.
1. Whatever your production schedules demand, we see that Accurate service satisfies them. You simply tell us what you want . . . when you need it . . . and that's when you get it. It's mighty important to us to deliver on time, because it's important to you.
2. There is the Accurate engineering department ready to serve you with its knowledge and experience — to help you work out problems of redesign, or to engineer a new spring for a new product. This is a service for you that costs you nothing while it can save you money and improve your product.
Use these two features of Accurate service. You'll certainly profit by them as sure as you'll profit by Accurate quality.
Send for your FREE COPY of the Accurate Handbook on springs. It's informative and compact.
Accurate Springs
ACCURATE SPRING MFG. CO.
3811 W. Lake Street Chicago, Ill.

LETTERS

EDITOR, AUTOMOTIVE INDUSTRIES:

Your editorial of Nov. 1, "A Pilot Pump and a Main Pump," interests me much, as I have given considerable thought to and have done some experimental work on the problem. A few remarks may be of interest.

It has been shown repeatedly, and we proved it to our satisfaction, that a Diesel engine can be made smoother by pilot injection, and that its output can be increased thereby. The requirement is to have a small injection sufficiently ahead of the main injection. The timing is important. We obtained good results (see AUTOMOTIVE INDUSTRIES, Oct. 29, 1938) when the pilot spray was not more than 15 per cent of the main spray and began 8 to 10 deg. before the main injection, in a small swirl chamber engine with 55 cetane fuel.

These results were obtained with two independent injection pumps and two independent spray nozzles. Referring to a recent British patent, which covers the combination of a separate pilot pump with a main injection pump, both discharging through a common delivery valve, you suggest a simplification by which the same effect would be achieved by a suitable cam mechanism that would give interrupted lifting motion to the needle valve.

It would be of little use to point out that this suggestion has been put forward several times in the past, the last time, as I remember, by D. Jafer in the Oct. 15, 1937, *Engineering*. The question is whether or not such a solution is promising.

It is the opinion of the writer that the discharge of a nozzle can be effectively controlled by the pump cam only when there is no injection line between the pump and the nozzle. If there is appreciable pipe length or volume between pump and nozzle, the effect of the cam profile diminishes and the result of a little hump on the cam may be imperceptible or completely obscured by the pipe and nozzle effect. This is because of the elasticity and inertia of the liquid fuel.

However, a pilot injection can ordinarily be produced even by a single conventional pump and a conventional differential nozzle

simply by selecting a nozzle orifice of a suitable size. If the nozzle orifice is small, then a continuous injection will result. If the nozzle orifice is very large, intermittent injection will take place. The nozzle then "chatters," opens, closes, opens, closes, and so on. The reason for this is simple. For the valve to open, the line pressure has to exceed the valve opening pressure of the spring loaded nozzle. Then discharge takes place at the rate of approximately $f\sqrt{2gp}/8$. If this rate is greater than the rate of pump delivery Fv (where f is the nozzle and F the plunger cross-sectional area respectively and v the plunger velocity), then the outflow is greater than the inflow, the line pressure will drop, and the nozzle closes. Then the play repeats.

Between these extremes, continuous injection and chattering, there is a middle way, "stuttering." In this case the nozzle only chatters once or twice at the gentle part of the cam profile and then the discharge becomes continuous. Of course, a reduction of pump speed, plunger diameter, or cam rise has a similar effect as the increase of nozzle orifice in producing a discontinuous injection.

The article of Oct. 29, 1938, in AUTOMOTIVE INDUSTRIES has shown such stuttering needle lift diagrams that displayed the characteristics of pilot injection with all of its benefits. It has been pointed out, however, that the effect is contingent on a certain engine speed. At lower speed, the pilot injection disappears and at higher speed it transforms into a full-size injection.

To make "stuttering" occur regularly over a wide speed range, the nozzle must be so designed that an appreciable pressure drop takes place after the first lift of the needle valve. There are ways to accomplish that.

P. H. SCHWEITZER,
THE PENNSYLVANIA STATE COLLEGE.

EDITOR, AUTOMOTIVE INDUSTRIES:

I have a question I would like to ask the automobile people. First, though, a little problem in arithmetic will lead up to the question.

Assume an automobile with 92 hp., a top speed of 90 m.p.h., and a force of 50 lb. (a constant practically) required to overcome the rolling friction. At 90 m.p.h. the hp. required to overcome the rolling friction is

$$50 \times 90 \times 44/30 \times 1/550 = 12.$$

$92 - 12 = 80$ hp. is required to overcome the air resistance. At 22½ m.p.h., the hp. required will be

$$12 \times 22\frac{1}{2}/90 + 80 \times (22\frac{1}{2}/90)^3 = 3 + 1\frac{1}{4} = 4\frac{1}{4}.$$

Assuming a value of 0.08 gallons per horse power-hour (a fair value for gasoline engines operating at optimum economy), the mileage should be

$22\frac{1}{2}/(.08 \times 4\frac{1}{2}) = 62\frac{1}{2}$ miles per gal.

Of course, this computed mileage will decrease with an increase in speed, but the value will be appreciably above that now obtained at the normal speeds at which automobiles are being driven.

Since this difference in gas mileage, as computed here and as now actually attained, can be considered as only a mechanical problem, why has not something been done about it in favor of the motorist?

This question, or something like it, should open up a discussion which in my opinion has been sadly neglected.

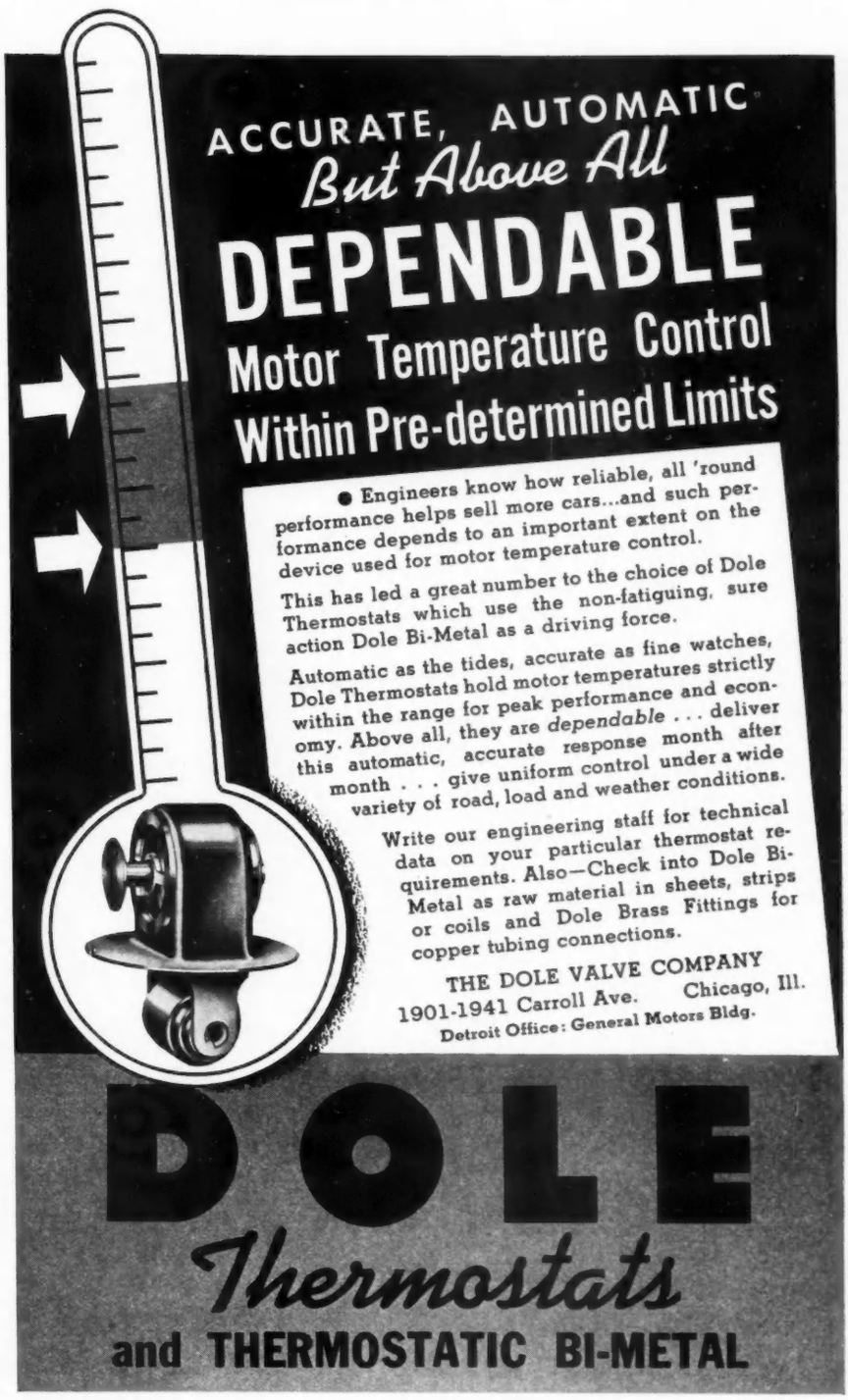
An AUTOMOTIVE INDUSTRIES Reader and Automobile Driver.

Your calculations are correct, but the assumption that you can produce one horse power-hour with a consumption of 0.08 gal. of gasoline when a 92-hp. engine is producing 4¼ hp. is wide off the mark. Under these conditions you will be doing well if your consumption is no greater than one quart (0.25 gal.) per horse power-hour. That we get relatively low mileages from our cars even when driving at low speeds is due to the fact that these cars have very powerful engines which at low car speeds are very lightly loaded, and at light loads the efficiency of the engines is low. The powerful engines are needed for acceleration and for high speeds on up grades. An overdrive, which increases the torque load on the engine for a given speed of travel, will raise the fuel economy.—Editor.

BOOKS . . . .

A.S.T.M. STANDARDS ON RUBBER PRODUCTS. *Published by the American Society for Testing Materials, Philadelphia, Pa.*

This compilation, issued under the auspices of A.S.T.M. Committee D-11 on Rubber and Rubber Products, gives thirty specifications and test methods in their latest form. Fourteen of the standards pertain to general methods involving chemical analysis, sample preparation, tension testing, accelerated aging, air-pressure heat test, abrasion resistance, adhesion, and a test for changes of properties of rubber and rubber-like materials in liquids. Other tests included are for flexing hardness, indentation, and resistance to light checking and cracking. Rubber hose and belting are covered in three standards, rubber gloves, matting and tape in five. There are five standards covering various types of insulated wire and cable; also standards for rubber cement, sponge and hard-rubber products.


ACCURATE, AUTOMATIC
But Above All
DEPENDABLE
Motor Temperature Control
Within Pre-determined Limits
● Engineers know how reliable, all 'round performance helps sell more cars...and such performance depends to an important extent on the device used for motor temperature control.
This has led a great number to the choice of Dole Thermostats which use the non-fatiguing, sure action Dole Bi-Metal as a driving force.
Automatic as the tides, accurate as fine watches, Dole Thermostats hold motor temperatures strictly within the range for peak performance and economy. Above all, they are dependable . . . deliver this automatic, accurate response month after month . . . give uniform control under a wide variety of road, load and weather conditions.
Write our engineering staff for technical data on your particular thermostat requirements. Also—Check into Dole Bi-Metal as raw material in sheets, strips or coils and Dole Brass Fittings for copper tubing connections.
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1901-1941 Carroll Ave. Chicago, Ill.
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Ourselves & Government

A Check List of Federal Action Corrected to Jan. 25

Federal Trade Commission

F. O. B. PRICE CASE—Trial examiners' hearing held in Ford case in Detroit on Nov. 2. Next step will be trial examiners' report. Testimony closed in GM case, with trial examiners' report having been served on respondent company. After final arguments, the FTC order is next in line.

VS. GENERAL MOTORS—Trial examiners' report due. Rebuttal testimony concluded Sept. 11. The FTC charge is that GM dealers are required to handle GM parts exclusively.

FAIR TRADE PRACTIC RULES—No indication when rules, now long over due, will be promulgated.

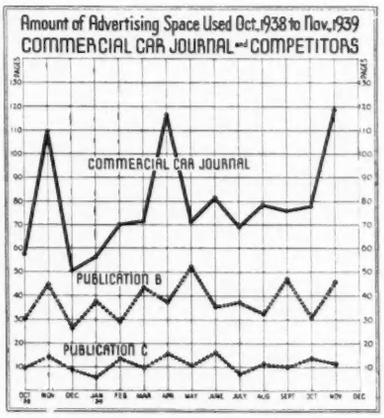
Lothair Teetor Elected Head of Indiana C of C

Lothair Teetor, president of the Perfect Circle Co., Hagerstown, Ind., has been elected president of the Indiana State Chamber of Commerce. Mr. Teetor succeeded John E. Frederick, Kokomo industrialist, who had been head of the organization for several years.

'39 Rim Inspections Gained 65% Over '38

Total number of rims inspected and approved by the Tire & Rim Association, Inc., during December, 1939, is reported at 2,070,799, an increase of approximately 14 per cent over the same month a year ago. For the entire year of 1939, the Association reports a total of 17,471,914 rims inspected and approved. This is an increase over 1938 of roughly 65 per cent.

COMMERCIAL CAR JOURNAL


Amount of Advertising Space Used Oct.1938 to Nov.1939
COMMERCIAL CAR JOURNAL and COMPETITORS
COMMERCIAL CAR JOURNAL
PUBLICATION B
PUBLICATION C

Leads in Advertising Volume

The chart, of course, tells the story of COMMERCIAL CAR JOURNAL leadership. Any publication, head and shoulders above the others in its field, has the confidence of the manufacturers in its industry—and is getting results for them.

We started making these charts in 1935. They all look about alike — with COMMERCIAL CAR JOURNAL always out in front. It is the No. 1 Truck Fleet publication, with 30,000 circulation monthly.

COMMERCIAL CAR JOURNAL

A Chilton Publication

Chestnut & 56th Sts. Philadelphia, Pa.

Labor

(*Continued from page* 125)

UAW-CIO and the UAW-AFL, claims which the contemplated elections are expected to eliminate. Meanwhile a committee representing the UAW CIO began meetings with representatives of GM on Jan. 24 on a series of demands covering interpretation of the present contract.

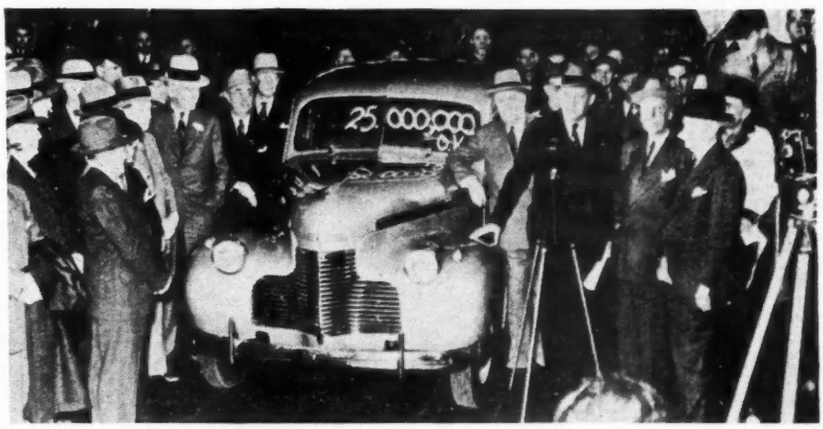
George Romney

. . . Detroit office manager of the Automobile Manufacturers Association was official host at a luncheon on Jan. 18, marking the installation of the bulk of A.M.A. functions in Detroit. Pyke Johnson, as general manager of the association, retains his Washington office and will divide his time between Washington and Detroit. Alfred Reeves, as advisory vice-president and show manager, retains his New York office, and the Automotive Safety Foundation, now in New York, will move to Washington "some time between May 1 and October 1." Otherwise, the activities of the A.M.A. occupy new quarters in the New Center Bldg., Detroit.

No. 25,000,000

On the occasion of completion of the twenty-five millionth car (a Chevrolet) built by General Motors, executives of the corporation joined employes on Jan. 11 in celebration ceremonies at the Chevrolet assembly plant in Flint, Mich. Left to right in the picture above are: M. E. Coyle, Chevrolet general manager; W. S. Knudsen, president of GM; A. P. Sloan, Jr., chairman of the board of GM; and C. E. Wilson, executive vice-president of GM.

Festivities were projected into the evening, including a program entitled "March of Men and Motors" which played before some 5000 person assembled in the Masonic Temple at Detroit.



Acme

CALENDAR

Conventions and Meetings

SAE National Aeronautic Meeting, Washington .....Mar. 14-15
SAE National Transportation & Maintenance Meeting, Pittsburgh.Mar. 28-29
Chamber of Commerce of the United States, Annual Convention, Washington, D. C. .....April 30-May 2
SAE Summer Meeting, White Sulphur Springs, W. Va. .....June 9-14
American Society for Testing Materials, Annual Convention, Atlantic City, N. J. .....June 24-28

Shows at Home and Abroad

Leipzig Trade Fair, Germany, March 3-10,1940

American Foundrymen to Meet in Chicago, May 4

The forty-fourth annual convention of the American Foundrymen's Association and Foundry and Allied Industries Show will be staged in Chicago, May 4-10. C. E. Hoyt is manager of exhibits.

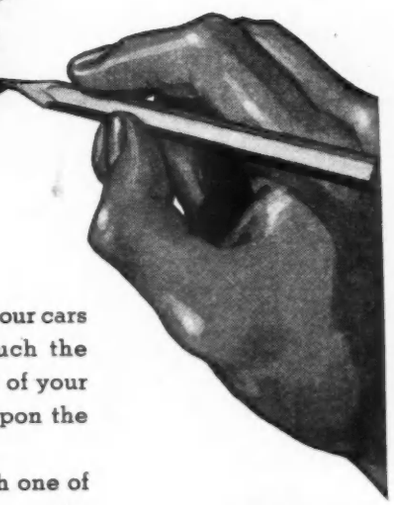
Plant visits will start Monday, May 6, with a special group trip inspection of the mills and blast furnaces of the Wisconsin Steel Division of the International Harvester Co. During the week, many of the foundries and industrial plants of the district will be open for small group or individual inspection trips.

First Use of Laminated Safety Glass

In the article "A Decade of Automotive Development," published in our issue of Jan. 15, the first use of laminated safety glass in automobiles was credited to Cadillac in 1929. This was an error, as the Ford Model A, which appeared on the market early in 1928, had laminated safety glass in the windshield. Laminated glass had been used in custom-built vehicles some years earlier, but the compilation was intended to cover regular production practices only.

Faithfully yours . . . and your customers'

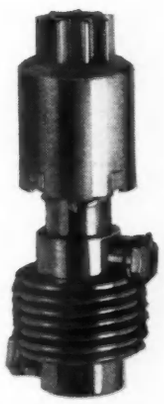
Bendix Drive



First contact your customers have with your cars and trucks is at the moment they touch the starter button. Much of what they think of your product through its lifetime depends upon the efficiency and reliability of starting.

Isn't it well worth while to make each one of those thousands of starts fortify owner satisfaction? You are sure of doing just that when you provide the Bendix Drive. For the Bendix Drive, backed by hundreds of billions of effortless starts, makes starting simple, foolproof and automatic.

There's a Bendix Drive especially engineered for every type of starter control — foot button, clutch or accelerator pedal, dash button or with Startix, completely automatic switch key starting. Specify the Bendix Drive and increase owner satisfaction.



ECLIPSE MACHINE DIVISION
BENDIX AVIATION CORPORATION
ELMIRA, NEW YORK

"The mechanical hand that cranks your car"

The Motor Boat Show

(*Continued from page* 105)

five engines on display were of small output, ranging from ½ to 4 hp., and are designed with a patented high-tension magneto built into the flywheel.

This year Buda showed a range in engine output from 0.6 hp. to a 150-hp. Diesel. The newest unit has six cylinders, 3⅝ by 5⅛ in., and is rated at 90 hp. A complete line of "air-jacketed" marine engines were also shown. They develop about 1½, 2¼, and 5¾ hp., respectively. The "air-jacketing" feature gives advantages of water cooling at lower cost, eliminates pumps, and permits of idling without overheating, it was claimed. They are equipped with built-in reverse and reduction drive, with free-wheeling in neutral.

Caterpillar Tractor Co. showed a new, small V-8, 135 hp., a new 100 hp., and a 35 hp. engine. Simplified installation has been developed. The larger units come equipped with a gasoline engine for starting under adverse weather conditions.

Chris-Craft's line this year is the largest ever offered, with 14 engines ranging in output from 60 to 350 hp. Among the new features offered by these gasoline engines are new herringbone water pumps, silchrome steel exhaust valves, statically and dynamically balanced crankshafts, special non-drip safety type carburetors, and forced feed lubrication throughout the whole line. Combustion chambers have been redesigned to produce higher power. The company offered this year its new 160-hp. engine, 4½ by 4¾ in., 404 cu. in. displacement. The V-8 is the largest of the line, available with a high-compression head and dual downdraft carburetors.

Chrysler's marine line has been subjected to some slight improvements, and representatives countered questions about Diesels with "we'll have one soon." The Royal Eight has increased power, 76 to 143 b.hp. at 1600 and 3200 r.p.m., respectively.

A new General Motors Diesel, developed by the Cleveland Diesel division for the Government, was on display. It is an eight-cylinder unit, designed with unusual compactness. Details were not revealed.

Consolidated Shipbuilding Corp. showed its Speedway, ranging in sizes from 25 to 300 hp.

Cummins Engine Co. introduced its new 125-hp. supercharged Diesel among its showing of five engines. The engine is similar to the Model A. It is claimed that the supercharged unit develops one hp. to every pound of weight.

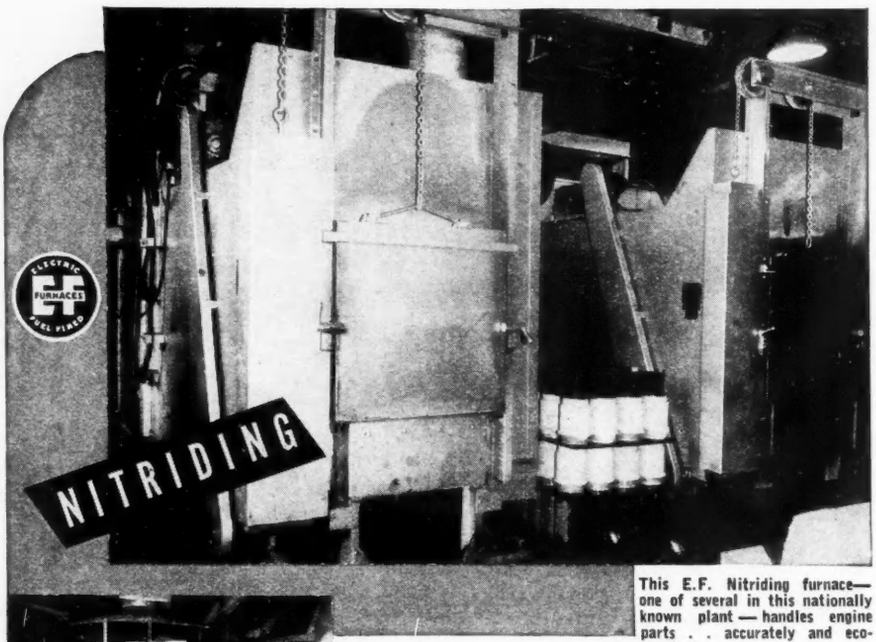
A single-cylinder, 3½ by 4¾ in. unit, operating at 1200 r.p.m., designed for auxiliary service, was Fairbanks-Morse's new offering. A veteran in heavy Diesel building, the company reports a lively market in both marine and stationary applications. Reduction of power costs and more dependable service than is customary in some localities, are sales points. Its biggest engine at the show was an eight, with 8 by 12½ in. bore and stroke.

Both the Diesel and gasoline lines of Gray Marine Motor Co. have been augmented. A total of 25 sizes is offered, each with a new reverse band of molded asbestos lining. A new light four gasoline unit, improved models in the larger sizes, and five G. M. Diesels were shown. The Diesels all have 4¼ by 5 in. cylinders, the units being of one, two, three, four, and six cylinders, with all working parts interchangeable.

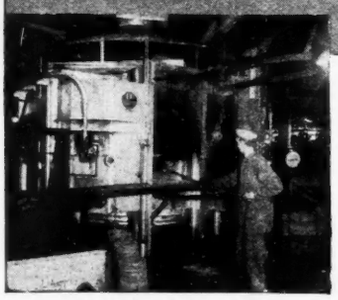
Hall-Scott brought out a new V-12, 630-hp. engine, designed along the lines of its 275-hp. Invader Six. It is a 5¾ by 7 in. unit, developing its rated output at 1200 r.p.m.

Kermath Mfg. Co. displayed three new engines, developed along the lines of its basic engineering design. The company showed two new Diesels of the Hercules type.

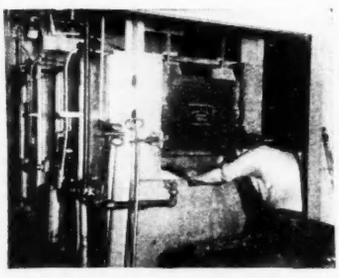
Lathrop Engine Co. brought out a four-cylinder, four-cycle Diesel, 5½ by



This E.F. Nitriding furnace—one of several in this nationally known plant — handles engine parts . . accurately and economically.



An E.F. Fuel Fired Rotary Furnace—used for normalizing and hardening — in the Wright Aeronautical Corp. plant.



An E.F. Chain Belt Conveyor Furnace used for heat treating a wide variety of parts in the Wright engine plant.

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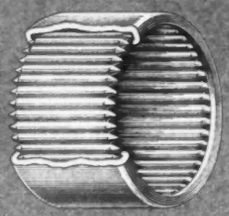
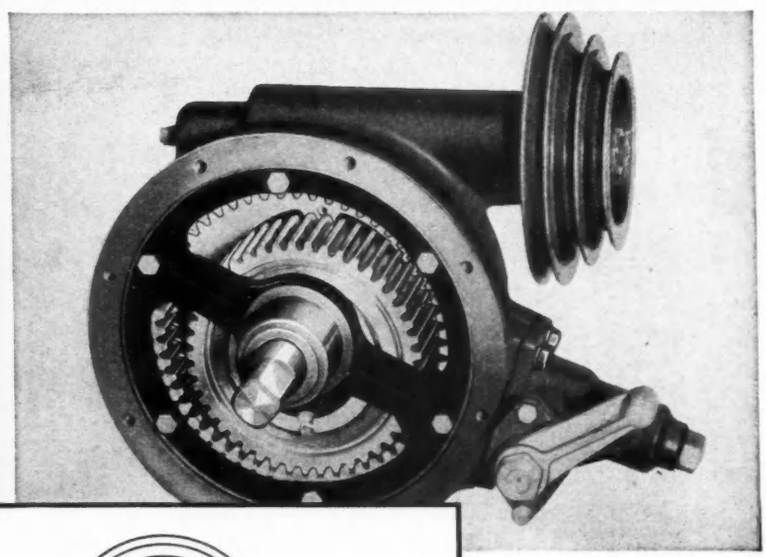
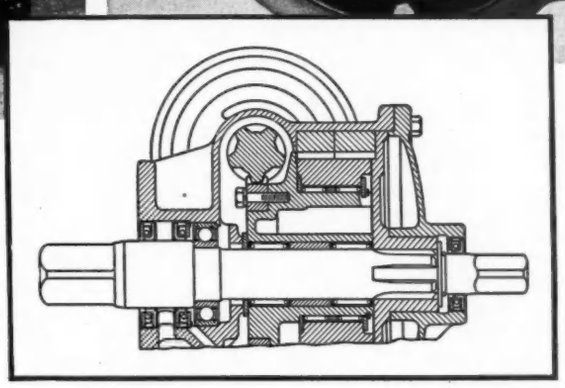


Winkler Stokers are built throughout for lasting service under severe conditions.



(*Above*) Heart of the stoker is the Winkler Automatic Transmission, in which Torrington Needle Bearings are used under heavy loading conditions.



(*Left*) Cross-section view of the transmission. Design requires extremely high speed reduction ratio.

UNUSUALLY high bearing loads—an extremely large speed reduction ratio—these are inherent problems in the design of stoker transmissions. And U. S. Machine Corporation, manufacturer of the powerful, rugged Winkler Stoker, solved them by using the Torrington Needle Bearing on its exclusive "INTER-PLAN" drive.

"The advantages of the Needle Bearing, with its tremendous load carrying capacities and very minimum of diametral requirements, make this type of bearing ideally adapted in the Winkler Stoker Drive," says Herman Winkler, Chief Engineer of U. S. Machine Corporation. "The ease with which lubrication problems may be handled with Needle Bearings also contributed substantially to the reasons for their selection in the 'INTER-PLAN' drive."

To test the performance of Winkler Stokers, a stoker transmission was run *continuously* for a full year, carrying a Prony brake load of *600% above normal* —the equivalent of 30 years' operation under ordinary conditions. At the end of the test, there was no noticeable wear *on a single part*—convincing evidence of long life of the Torrington Needle Bearing under severe loads.

Perhaps you, too, can profitably employ these advantages of this Needle Bearing in your own product. Let the Torrington Engineering Department show you how you can avail yourself of the bearing's high capacity, small size, ease of lubrication. For further information, write for Catalog No. 7. For Needle Bearings to be used in heavier service, request Booklet No. 103X from our associate, Bantam Bearings Corporation, South Bend, Indiana.

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NEEDLE BEARING

7 in., developing 50 hp. at 800 r.p.m., and a six-cylinder gasoline engine of 320 cu. in. displacement, developing more than 100 hp.

Mack Mfg. Corp. created a great deal of interest among yachtsmen and workboat owners alike with its two Diesels, recently described in AUTOMOTIVE INDUSTRIES. With unusually well-placed servicing facilities on both fresh and tide water boat owners were interested to learn that about 85 per cent of the engine is identical with parts used in the Mack truck Diesel.

Two new Diesels have been added to the Superior marine line by the National Supply Co. One, with a bore of 8½ in. and a 10½ in. stroke, can be had in five, six, or eight cylinder models, developing 195, 235, and 310 hp., respectively, at 700 r.p.m. Another new unit has four 5½ by 7 in. cylinders, and is rated at 90 hp. at 1200 r.p.m.

Palmer Bros. Engines, Inc., another veteran of the marine power field, brought out its first Diesels this year. They are a single-cylinder 9 hp. unit for electric plants ashore and afloat, and a four, developing 40 hp. at 1200 r.p.m. The Russell-Newbery design of combustion chamber is used by Palmer. The piston is of two diameters, the upper part forming a choke in an off-center combustion chamber, to produce additional turbulence. Cadmium silver bearings are used on the main shaft beds, and valves are removable without disturbing the cylinder heads.

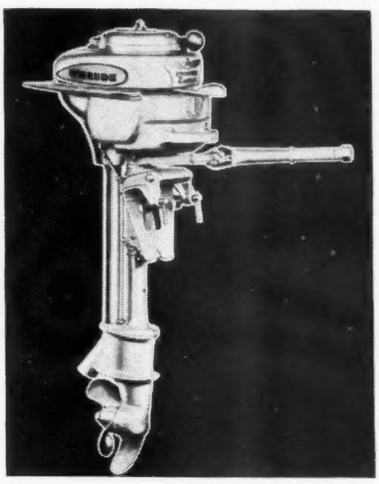
Red Wing Motor Co. introduced a Hesselman spark-Diesel developing 100 hp. at 1500 r.p.m. with its six 4½ by 5½ in. cylinders. Its range of gasoline engines runs from 4 to 125 hp., and its spark-Diesels from 35 to 200.

Scripps Motor Co. offered this year for the first time its Super-Hercules Diesel in four and six cylinder sizes with 4 by 4½ in. and 3¾ by 4½ in. cylinders, respectively. Slight changes have been made in the company's gasoline line.

Both gasoline and Diesel generating plants were shown by United States Motors Corp., a new addition being the 10 kw. Diesel. The line ranges from 400 to 800 watt output for the smaller units, and 3, 5, and 7½ kw., in one series, and 5, 7½, and 10 kw. in the other.

Waukesha Motor Co. showed its Hesselman type units in an 88 and a 215-hp. models.

Wisconsin Motor Co. has brought out a new air-cooled inboard of 4.2 hp., one of seven models shown in its exhibit. It is a single-cylinder unit with a 2⅞ by 2¾ in. bore and stroke.

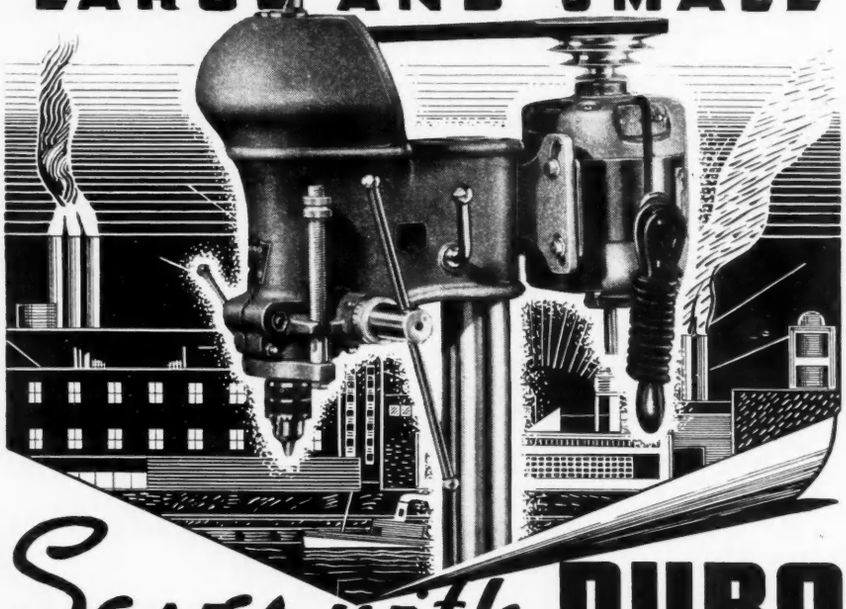


Evinrude Zephyr 5.4 hp. at 4000 r.p.m. Weight 43 lb.

A newcomer in the outboard motor field is the Kiefhaefer Corp., Cedarburgh, Wis., with a line of six units, in single and twin-cylinder design. Unusually trim in design, permitting a smooth flow of water around the shaft housing to the propeller, the engine has a spring steel reed type valve, die-cast aluminum alloy pistons, removable cylinder sleeve, and connecting rod. The latter is cast under 9000 lb. pressure. A novel eccentric water pump with a rubber working unit, is featured.

Muncie Gear Work's "Neptune," Elto, Evinrude and Johnson, all have new sizes to round out their respective lines. Lauson Co., builder of inboard units, has augmented its line with a series of outboard engines.

INDUSTRY
LARGE AND SMALL



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